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REPORT TO CONGRESS MINIMIZATION OF HAZARDOUS WASTE - VOLUME I

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Washington, DC

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Minimization of Hazardous Waste

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A

Report to Congress

Minimization of Hazardous Waste

Prepared by
Office of Solid Waste
U.S. Environmental Protection Agency
401 M Street, S.W.
Washington, D.C. 20460

October 1986

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B

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OCT 30 1986

THE ADMINISTRATOR

Honorable George Bush
President of the Senate
Washington, D.C. 20510

Dear Mr. President:

I am pleased to transmit the Report to Congress on Waste Minimization, in response to section 8002(r) of the Hazardous and Solid Waste Amendments (HSWA) of 1984.

As requested, this report evaluates the desirability and feasibility of (a) establishing standards of performance or of taking additional action to require generators of hazardous waste to reduce the volume or quantity and toxicity of the hazardous waste they generate; and (b) establishing, with respect to hazardous waste, required management practices or other requirements to ensure such wastes are managed in ways that minimize present and future risks to human health and the environment.

The Report, appendices and technical support document are transmitted in five separate volumes.

Sincerely yours,

Lee M. Thomas

Enclosures

c

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

OCT 30 1996

THE ADMINISTRATOR

Honorable Thomas P. O'Neill
Speaker of the House of Representatives
Washington, D.C. 20515

Dear Mr. Speaker:

I am pleased to transmit the Report to Congress on Waste Minimization, in response to section 8002(r) of the Hazardous and Solid Waste Amendments (HSWA) of 1984.

As requested, this report evaluates the desirability and feasibility of (a) establishing standards of performance or of taking additional action to require generators of hazardous waste to reduce the volume or quantity and toxicity of the hazardous waste they generate; and (b) establishing, with respect to hazardous waste, required management practices or other requirements to ensure such wastes are managed in ways that minimize present and future risks to human health and the environment.

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Sincerely yours,

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Enclosures

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Report to Congress

MINIMIZATION OF HAZARDOUS WASTE

Summary of Recommendations

The Environmental Protection Agency has concluded that mandatory standards of performance and required management practices are not feasible or desirable at this time. The Agency recommends that the effect on waste minimization of the land disposal restrictions and other HSWA mandates, as well as amendments to CERCLA, be quantified and analyzed. EPA will report back to Congress on this determination in December 1990, the earliest date at which it believes a recommendation on the need for a major waste minimization regulatory program could be made. Until that time, however, EPA recommends a three point waste minimization strategy:

Information Gathering

Continuing collection of information on waste stream volume and composition, generation rates by various types and sizes of generators, adequacy of capacity for TSD facilities, and the cumulative effect of HSWA requirements on voluntary waste minimization practices.

Core Waste Minimization Program

— Development and publication of informal guidance on waste minimization for the purpose of the reporting and certification requirements of HSWA Sections 3002 and 3005.

— Provision of a technical and information assistance program to generators and to States to aid in the development of waste minimization programs.

— Assistance to specific States to develop programs for providing direct technical assistance to generators (e.g., using waste audits, dissemination of technical information, applied research on new applications of existing technology).

— Highlight ongoing research and development and economic feasibility studies that might serve an entire region or have regional application.

— Development of an information system on waste minimization, accessible by the States.

— Implementation of mandatory controls, as needed, for controlling the generation of wastes for specific industries or processes using current authority under TSCA Section 6.

— Incorporation of waste minimization into the review of TSCA Premanufacture Notices.

Longer Term Options

After evaluation of information gathered in the short term, EPA may better assess in its 1990 report to Congress that additional authority to adopt mandatory standards of performance or management practices as a means of reducing wastes would be warranted.

In the interim, EPA will continue to examine the specific elements of the "core" waste minimization program and consider the need for longer term options, if needed. As part of the next RCRA reauthorization, EPA will provide Congress with its most current assessment of the need to modify the existing waste minimization requirements for generators and TSDFs. Among the possible options to consider would be:

— To prohibit, where appropriate, certification of certain types of waste management practices as waste minimization.

— To specify what may be certified as waste minimization.

— To define necessary documentation for certifications that state that waste minimization is not economically practicable.

H

Report to Congress on Minimization of Hazardous Waste

EXECUTIVE SUMMARY

This Report to Congress is submitted in response to the requirements of Section 8002(r) of the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act (RCRA) of 1976, and the Hazardous and Solid Waste Amendments (HSWA) of 1984.[1] Under this section, the Administrator of the Environmental Protection Agency (EPA) is required to submit a Report to Congress by October 1, 1986, recommending any legislative changes that are feasible and desirable to implement HSWA's policy with respect to the minimization of hazardous waste:

> The Congress hereby declares it to be the national policy of the United States that, wherever feasible, the generation of hazardous waste is to be reduced or eliminated as expeditiously as possible. Waste that is nevertheless generated should be treated, stored or disposed of so as to minimize the present and future threat to human health and the environment.

Section 8002(r) requires the Administrator to evaluate specifically the feasibility and desirability of:

1. Establishing standards of performance or of taking other additional actions under RCRA to require generators of hazardous waste to reduce the volume or quantity and toxicity of the hazardous waste they generate; and

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[1] Reflecting common usage, the amended Solid Waste Disposal Act will hereafter be generally referred to as RCRA. Additions to RCRA made by the 1984 amendments will be referred to in the text as HSWA.

2. Establishing, with respect to hazardous waste, required management practices or other requirements to ensure such wastes are managed in ways that minimize present and future risks to human health and the environment.

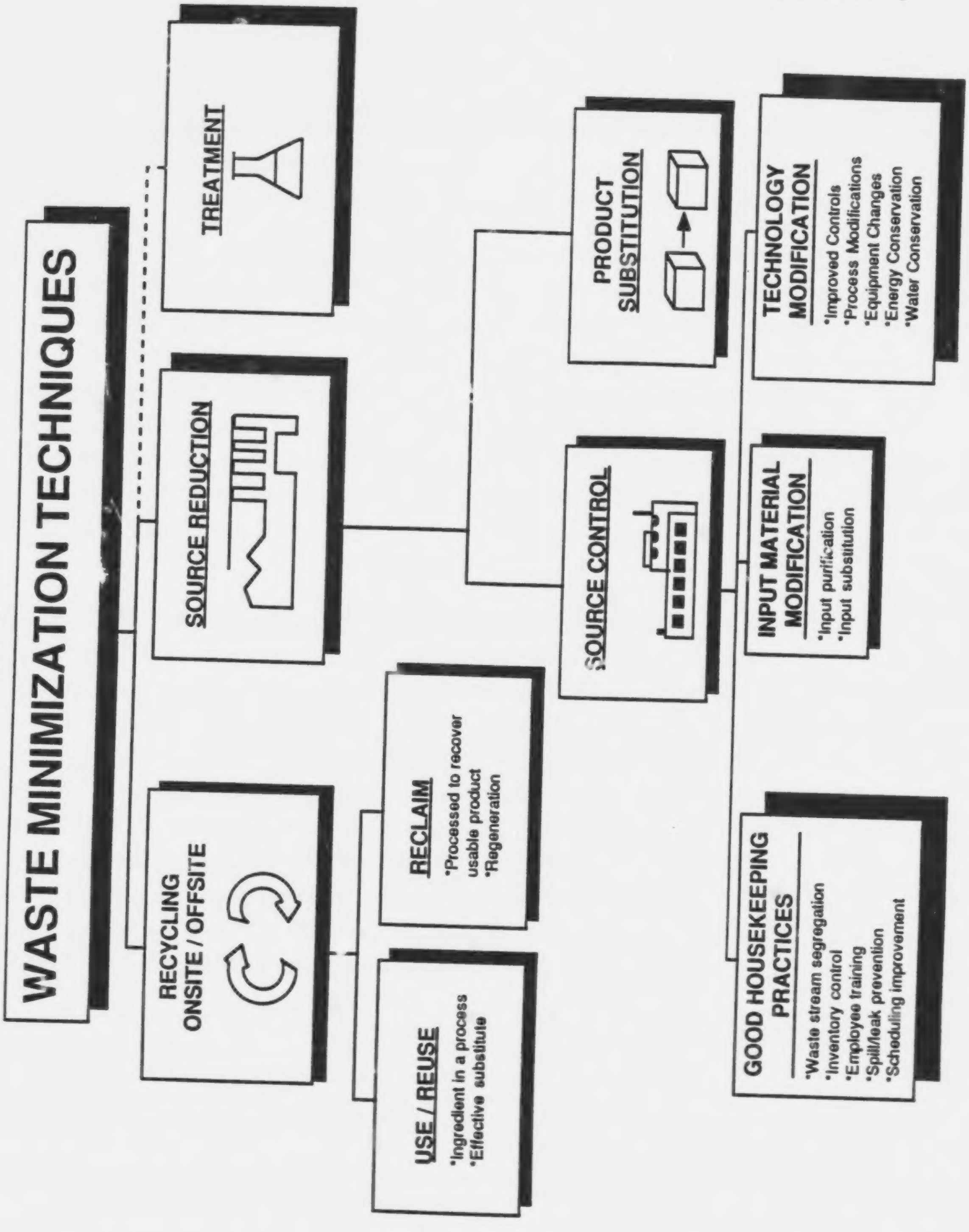
Definition of Terms

The following definitions, based in part on the interpretations presented below, are crucial to the recommendations made in this report (see also Figure 1):

> **Source reduction** refers to the reduction or elimination of waste generation at the source, usually within a process. Source reduction measures can include some types of treatment processes, but they also include process modifications, feedstock substitutions or improvements in feedstock purity, various housekeeping and management practices, increases in the efficiency of machinery, and even recycling within a process. Source reduction implies any action that reduces the amount of waste exiting from a process.
>
> **Recycling** refers to the use or reuse of a waste as an effective substitute for a commercial product, or as an ingredient or feedstock in an industrial process. It also refers to the reclamation of useful constituent fractions within a waste material or removal of contaminants from a waste to allow it to be reused. As used in this report, recycling implies use, reuse, or reclamation of a waste either onsite or offsite after it is generated by a particular process.
>
> **Waste minimization** means the reduction, to the extent feasible, of hazardous waste that is generated or subsequently treated, stored, or disposed of. It includes any source reduction or recycling activity undertaken by a generator that results in either (1) the reduction of total volume or quantity of hazardous waste, or (2) the reduction of toxicity of hazardous waste, or both, so long as the reduction is consistent with the goal of minimizing present and future threats to human health and the environment.

In the broadest sense, the HSWA defines waste minimization as any action taken to reduce the volume or toxicity of wastes. That definition includes the concept of waste treatment, which encompasses such technologies as incineration, chemical detoxification,

FIGURE 1


WASTE MINIMIZATION TECHNIQUES
RECYCLING ONSITE / OFFSITE
SOURCE REDUCTION
TREATMENT
USE / REUSE
*Ingredient in a process
*Effective substitute
RECLAIM
*Processed to recover usable product
*Regeneration
SOURCE CONTROL
PRODUCT SUBSTITUTION
GOOD HOUSEKEEPING PRACTICES
*Waste stream segregation
*Inventory control
*Employee training
*Spill/leak prevention
*Scheduling improvement
INPUT MATERIAL MODIFICATION
*Input purification
*Input substitution
TECHNOLOGY MODIFICATION
*Improved Controls
*Process Modifications
*Equipment Changes
*Energy Conservation
*Water Conservation

biological treatments, and others.[2] The Agency has already embarked on a broad program for waste treatment; thus, this report focuses on source reduction and recycling, the two aspects of waste minimization where basic options still remain open.

Section 1003 of HSWA establishes the general national policy in favor of waste minimization and refers to the need to reduce the "volume or quantity and toxicity" of hazardous wastes. EPA does not interpret this language to indicate that Congress rejected volume reduction alone (with no change in the toxicity of hazardous constituents) as being a legitimate form of waste minimization. A generator that reduces the volume of its hazardous waste, even if the composition of its waste does not change, is accomplishing beneficial waste minimization. EPA believes that waste concentration may occasionally be a useful waste minimization technique (e.g., in preparing materials for recycling). The key concept, however, is that waste minimization must be protective of human health and the environment.

Because both volume and toxicity of wastes present dangers to human health and the environment, measuring the effectiveness of waste minimization will be complex. First, waste minimization measures are likely to be process and industry specific, implying that different measurement techniques might be needed in different contexts; second, any mandatory requirements for reducing the volume or toxicity of generated waste should directly relate to expected reductions in risk to human health and the environment. EPA has already developed data and methodologies that can be used to evaluate the risks of many types of waste streams, as well as the risk reductions associated with waste management practices.[3] These evaluation techniques will continue to improve and become more effective as a tool in regulatory decision making. EPA therefore intends to use such assessments as a means of measuring progress in waste minimization and to help establish priorities among or within possible waste minimization regulatory schemes. This approach is consistent with the general principle that any waste minimization regulations should seek to reduce significant remaining risks.

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[2] Section 1003(a)(6) of HSWA states that the objectives of "promot[ing] the protection of health and the environment and conserv[ing] valuable material and energy resources" can be done by "minimizing the generation of hazardous waste and the land disposal of hazardous waste by encouraging process substitutions, materials recovery, properly conducted recycling and reuse, and *treatment*" [italics added].

[3] These include, for example, the Liner Location Model and the RCRA Risk/Cost Analysis Model (usually referred to as the Waste-Environment-Technology or W-E-T model).

Why Minimize Waste?

The RCRA program over the past ten years has focused primarily on correcting the effects of years of poor management of hazardous wastes by bringing treatment, storage, and disposal facilities into compliance with national standards that are protective of human health and the environment. HSWA has continued this policy, but has also shifted the emphasis of the program away from reforming land disposal practices to a reliance on waste treatment. Because of its potential for contamination of other environmental media (e.g., ground water), land disposal—even under strict control—is recognized as the least desirable method of managing hazardous wastes.

The move toward treatment is a major step forward, but is not a complete answer. Reforms in land disposal practices and installation of new hazardous waste treatment capacity are effective responses to managing this country's hazardous waste, but they do not address the generation of these wastes. Both Congress and EPA believe that preventing the generation of a waste, when feasible, is inherently preferable to controlling it after it is generated. Waste minimization can be viewed as a means of reducing the introduction of hazardous constituents into all environmental media.

Current environmental control programs are designed to protect human health and the environment. However, control technologies are never 100 percent efficient, and compliance with regulations under any environmental program can never be perfect, even with the most stringent enforcement program. Waste minimization can also address the risks of breakdowns in waste management systems.

In addition to achieving human health and environmental benefits by reducing the volume and/or toxicity of hazardous wastes, waste minimization can also relieve shortages of treatment, storage, and disposal capacity. The capacity to accept wastes diverted from land disposal will be especially limited over the next few years while new facilities are under construction and treatment alternatives are being developed. This process may be slow, since public opposition makes new hazardous waste facilities extremely difficult to site. Furthermore, land disposal will continue to be required into the foreseeable future, even if wastes disposed of in or on the land are detoxified first; hence, capacity needs will always be a concern. Finally, all forms of waste management—treatment or land disposal—must allow for industrial growth and thus the need for additional capacity. By reducing per unit product generation rates, waste minimization can provide at least a partial answer to these problems.

Incentives and Disincentives for Waste Minimization

Strong incentives already exist to promote waste minimization in the private sector, including (1) dramatic increases in the price of all forms of hazardous waste management, partially caused by Federal and State standards, (2) difficulties in siting hazardous waste management capacity, (3) permitting burdens and corrective action requirements, (4) financial liability of hazardous waste generators, (5) sharp increases in the cost of commercial liability insurance, coupled with a steep dropoff in its availability, and (6) public pressure on industry to reduce the production of waste. There are also countervailing disincentives. Figure 2 covers the incentives and disincentives that surround the various waste minimization techniques.

Incentives for Waste Minimization

Increases in the costs of hazardous waste management: EPA and State regulations have been the primary cause of increased costs in treatment, storage, and disposal of hazardous wastes, especially in relation to landfills, surface impoundments, and storage and accumulation tanks. The current series of land disposal restrictions under HSWA will limit the number of untreated wastes that can be disposed of on land and thus are likely to increase the cost of disposal. HSWA also imposes more stringent standards on surface impoundments, which will mean that about half of those now in operation will close. In addition, the recently promulgated hazardous waste tank rules[4] will

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[4] 51 FR 25421, July 14, 1986

	Source Reduction	Offsite Recycling	Onsite Recycling
INCENTIVES			
Increased Cost of Waste Management	●	●	●
Difficulties in siting new HW management facilities	●		●
Permitting Burdens and Corrective Action Requirements	●	●	●
Financial Liability of HW Generators	●		●
Shortages of Liability Insurance	●		●
Public Perception	●	●	●
DISINCENTIVES			
Economic Barriers			
–Lack of Capital	●		●
–Financial Liability		●	
Technical Barriers			
–Attitudes toward unfamilar methods	●	●	●
–Batch Processes			●
–Lack of information	●	●	●
–Technical Limits of Process	●		
–Technical Quality Concerns	●		
Regulatory Barriers			
–Need to Obtain TSD Permit	●	●	●
–Perceived Stigma of Man'g Haz. Waste		●	●
–Revisions to Other Env. Permits	●	●	●

FIGURE 2 INCENTIVES AND DISINCENTIVES FOR VARIOUS WASTE MINIMIZATION TECHNIQUES

also increase waste management costs. Because of these three factors, generators must find alternative means for treating, storing, or disposing of their wastes.

Prices for such alternative waste treatment are expected to rise as generators compete for scarce treatment capacity (such as incineration or chemical detoxification). EPA has, in fact, already identified shortages of treatment and disposal capacity for solvent and dioxin wastes in its proposed regulations.[5]

Overall, the increased costs of waste management provide a strong incentive for owners and operators to reduce the quantity of waste generated or disposed of through the use of source reduction and offsite and onsite recycling techniques.

Difficulties in siting hazardous waste treatment, storage, and disposal capacity: The land disposal restrictions program, as mandated by HSWA, is creating a strong demand for substantial new waste treatment, storage, and disposal capacity. Hazardous waste managers are therefore seeking new sites and planning to expand existing ones, but in the process they are encountering the familiar problem of "not in my community." While there are some instances where States have been successful in helping to site new hazardous waste management facilities, local resistance tends to be extremely hard to overcome. This intense public opposition to the siting of many types of hazardous waste facilities may cause shortages to persist even when market demand is strong. Generators' only alternative in many cases may therefore be a reliance on source reduction and onsite recycling to reduce the amount of waste they would otherwise send to offsite management facilities.

Permitting burdens and corrective action requirements: Even though the demand for new treatment and disposal capacity will be high, permitting procedures will tend to delay the availability of that new capacity, temporarily driving up the costs of all forms of treatment and disposal. No new hazardous waste management facility may be constructed until it has acquired a RCRA permit—a costly process that usually takes several years to complete. In addition, all permits issued after November 8, 1984, include provisions requiring owners and operators to take corrective action for releases of hazardous waste, regardless of when it was placed in the unit, both within *and beyond* property boundaries as necessary to protect human health and the environment. This potentially very expensive requirement applies to all facilities seeking a new RCRA permit, including both existing and new facilities. Additionally, even though the demand for new treatment and disposal capacity will be high, permitting procedures will tend to delay the availability of that new capacity, temporarily driving up the costs of all forms of treatment and disposal.

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[5] 51 FR 1729, January 14, 1986

Thus, the increased costs of permitting burdens and corrective action provide still another strong incentive for owners and operators to reduce the quantity of waste generated or disposed of through the use of source reduction and offsite and onsite recycling techniques.

Financial liability of hazardous waste generators: Generators using offsite treatment, storage, or disposal face financial liability for two reasons: (1) there is a potential for mismanagement of wastes by facility operators, and (2) there is the possibility of improper design of the disposal facility itself. Even careful evaluation of facility management cannot reduce these risks to zero. A generator risks incurring liability when the treatment, storage, or disposal facility (TSDF) owner or operator cannot or will not pay for remedial or corrective actions made necessary by migration of wastes. In these situations, generators can be held liable under common law for absolute, strict, joint and several liability. In addition, the imminent and substantial endangerment provisions in Sections 106 and 107 of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), state a generator or generators can be held financially responsible for the entire cleanup or restoration of a facility. When less waste is generated, it reduces potential liability for future disposal and thus is an incentive for both source reduction and onsite recycling.

Shortages of liability insurance: The traditional means for obtaining coverage for potential hazardous waste management liabilities is through insurance, but, for many generators and owners or operators of TSDFs, liability insurance is no longer available, or is available only at extremely high cost. This is particularly true of Environmental Impairment Liability (EIL) insurance, which until 1985 was an often-used financial instrument for generators and owners and operators of TSDFs to protect themselves from third-party and government claims for damages resulting from environmental releases of hazardous substances. In recent years, premiums have increased 50 to 300 percent, policies have been cancelled even where loss ratios have been excellent, and many companies have difficulty obtaining coverage at any price. In order to insure themselves against liability, TSDFs who must comply with Sections 3004 and 3005 (e) of RCRA[6] have resorted to creative methods to obtain coverage.[7] Until fundamental changes occur in the insurance marketplace, many generators and TSDFs will continue to have difficulty meeting liability requirements.

Increases in insurance costs or an inability to obtain insurance will result in higher treatment and disposal costs or the loss of available treatment or disposal capacity. This will provide a strong incentive to reduce the quantity of waste to be disposed of through the application of source reduction and onsite recycling techniques.

Public perception of company responsibilities: While the strongest incentives for implementing waste minimization techniques are probably economic, many companies are establishing waste minimization programs out of sensitivity to public concern over toxic chemicals. This type of corporate good citizenship is felt to produce good relations between industry and the public. Available information indicates that the larger companies are most likely to perceive public relations benefits in waste minimization; however, some medium and small size companies are acting under the same motives.

Disincentives for Waste Minimization

Economic barriers: Even though waste minimization practices often lead to cost savings, availability of capital for plant modernization is often a significant obstacle to their implementation. Although major companies may have sufficient access to upgrade inefficient processes, small and medium sized companies often do not. Firms that have recently modernized their facilities have reduced incentive to reinvest in alternative processes. Obstacles to plant modernization adversely affect the implementation of source reduction and onsite recycling when these involve process modifications.

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[6] Generators do not have to obtain liability insurance under RCRA.

[7] New instruments they have developed include: (1) formation of associations—captive stock or mutual insurance companies, (2) licensed carrier fronting programs for trust funds in which banks hold funds to cover liability, (3) letters of credit, (4) self insurance, and (5) corporate guarantees.

Financial liability can, in at least one circumstance, also be a significant disincentive for waste minimization because generators who send waste offsite may be liable under CERCLA and common law for damages caused by their wastes, even if the wastes have left the plant and are no longer under the firm's control. They may therefore not use available offsite recycling.

Technical barriers: Some firms may be reluctant to make any modifications to their production processes for fear of risking the technical quality of their final product. While these fears may not be well-founded, they can be a significant impediment to innovation.

There may also be, however, significant practical limits to waste minimization, especially with respect to source reduction, even where firms are actively seeking to minimize waste. Certain products simply cannot be manufactured without producing hazardous wastes; excessive waste minimization requirements would, in such cases, remove products from the market or put companies out of business entirely. A hazardous waste analog to the zero discharge policy, calling for across-the-board cuts of fixed percentages of waste generated, is therefore not realistic because, in some situations, possible source reductions may turn out to be minor and achievable only at great expense.

Another technical consideration affecting waste minimization is that industries producing high volume or high toxicity wastes often operate largely through batch processes. This can present problems for certain onsite recycling techniques (e.g., while light colored off-specification batches of paint can be blended into subsequent darker colored batches, the opposite is not always true).

Similarly, offsite recycling is often technically limited by process realities and administrative logistics. Off-specification chemicals (such as pesticides or pharmaceuticals) are examples of products with little onsite or offsite recycling potential. Even where wastes are technically recyclable, it may be difficult to accumulate enough waste to make the activity economically attractive. With respect to offsite recycling, it may be hard to establish permanent and stable relationships, either onsite among various production lines or offsite among firms; generator and user processes have to be synchronized, purity may vary over time, volumes of wastes available may not meet minimum reuse needs, transportation costs have to be acceptable, and price variations in feedstocks and in product prices inevitably play a crucial role.

Finally, the most significant technical barrier to waste minimization may often be a lack of suitable engineering information on source reduction and recycling techniques. Available information suggests that this is most often the case with small and medium sized companies.

Regulatory barriers: Some of the provisions of current environmental statutes, including RCRA, tend to discourage waste minimization. Some examples include the following:

- Source reduction sometimes requires the installation of new machinery that can, under RCRA, be considered "treatment." This in turn may require a plant to obtain a permit as a treatment, storage, and disposal facility (TSDF).
- Commercial recycling facilities that wish to increase their operations might be reluctant to do so if the expansion were to require a revision of their NPDES water pollution permit to authorize a change in the composition of their discharges or allow for larger flows.
- The new definition of solid waste, promulgated by EPA to eliminate loopholes in RCRA controls and inhibit unsafe (or "sham") recycling, brings some additional wastes into the hazardous waste system. This seems to be inhibiting some plants from sending these wastes offsite for recycling, since many companies perceive that manifested wastes present greater financial liability for offsite activities out of their immediate control. In addition, out of anxiety over potential financial liabilities, some companies not currently in the hazardous waste system may be reluctant to undertake any waste minimization program that would require them to accept manifested hazardous waste (e.g., certain offsite recycling practices) or take other measures that would bring them officially into the hazardous waste management system.

Current Waste Minimization Requirements

At present, there are three formal statutory requirements relating to waste minimization, all of them enacted as part of the 1984 amendments.

1. Section 3002(b) of HSWA requires generators to certify on their waste manifests (mandated under Section 3002(a)) that they have in place a program "to reduce the volume or quantity and toxicity of such waste to the degree determined by the generator to be economically practicable."

2. Section 3005(h) of HSWA requires the same certification in relation to any new permit issued for treatment, storage, or disposal of hazardous waste.

3. Section 3002(a)(6) of HSWA requires, as part of any generator's biennial report to EPA, that the generator describe "the efforts undertaken during the year to reduce the volume and toxicity of waste generated" as well as "changes in volume and toxicity of waste actually achieved during the year in question in comparison with previous years, to the extent such information is available for years prior to enactment of [HSWA]."

These requirements should increase the awareness of generators and facility owners and operators of the importance of minimizing hazardous wastes, and might serve as the basis for more specific and farther reaching requirements. However, the present requirements are not restrictive; the generator determines whether any particular waste minimization approach that might apply to his or her process is economically practicable.

Although the biennial reports should provide useful insight into what generators are actually doing to reduce wastes, they are not likely to provide definitive information. The reports due this year (1986) will be the first to include waste minimization requirements, and the quality of information they contain is expected to vary widely. As yet, for example, there is no formal definition of the meaning of the term "toxicity," or any guidance on the way to measure waste volume. In addition, generators are not likely to provide information that they consider confidential.

EPA is therefore conducting a study to determine how the waste minimization statement on the biennial report can be modified to improve the quality of information being reported. The Agency plans to provide uniform guidance directly to the States and to generators on the content of these reports in time for their 1988 submission. Future information provided in the report will then allow EPA to better identify trends in waste minimization technologies applied by generating facilities.

Evaluation of Available Options for Waste Minimization

Congress specifically required the Agency to report on the desirability and feasibility of establishing mandatory standards of performance for waste minimization or of taking additional actions under RCRA to reduce the volume or quantity and toxicity of hazardous waste and of establishing required management practices to achieve minimization. It also requested any recommendations for legislative changes to implement the national policy of waste minimization. This report details EPA's evaluation of the following options to minimize hazardous wastes.

Standards of Performance

Mandatory standards of performance for minimizing wastes could take various forms, but in all their variations they are markedly different in concept from the type of performance standards typical of the air and water pollution control programs. In these other programs, performance standards are end-of-pipe standards that allow flexibility to modify processes or add control technologies. Performance standards for waste minimization would depend substantially on internal modifications of industrial processes. Such standards would mark a major departure from past practice and would require statutory amendments. At present, mandatory performance standards are not authorized under RCRA.

EPA has evaluated three variations of performance standards in this report:

1. Specific standards limiting the volume or toxicity of wastes,
2. Prohibition or restriction of specific waste streams, and
3. A phasedown permit system, wherein total waste generation levels for one or more industries or waste streams are specified and then

reduced ("phased down") over time. Under this option, trades among firms for generation rights would be encouraged.

EPA believes that all these options raise significant implementation concerns and should be adopted only after careful evaluation of emerging trends and patterns of waste generation. It is important that the option selected be the most effective method to minimize hazardous waste for a particular industry. All performance standard options would be costly and time consuming to design and would, therefore, be infeasible to implement in the next four to six years. If it becomes clear after implementation of the land disposal restrictions program that there are specific residual hazardous waste problems that are not being resolved through response to these requirements, then additional prescriptive action may be appropriate. EPA might find that the Toxic Substances Control Act (TSCA), especially Section (6)(a)(A), is a more appropriate method than RCRA regulations to resolve residual hazardous waste problems.

A comprehensive command-and-control performance standard program of the traditional type would cost on the order to $5 to $7 million per standard to design and implement, and would require staff commitments at least as high as the effluent guidelines program for water or the new source performance standards program for air. At the present time, however, there are hundreds of discrete industrial processes to examine, and it is difficult to project without further information how many may require standards. Under the most realistic circumstances, it would take at least ten years after Congressional authorization to design and fully implement such a program.

Prohibition or restriction of specific wastes would presumably be simpler in regulatory structure and more selectively applied than performance standards, but would still require extensive research into processes and waste management techniques. Furthermore, responsible use of prohibition authority often requires substantial analysis of the feasibility of less severe measures and, therefore, can also be costly to evaluate.

A phasedown permit system would be somewhat different in concept and operation from a command-and-control performance standard approach. Because it would not set specific engineering standards for each industry, the burden on EPA for developing the program would be considerably less than for a conventional standard-setting process.

Incentives for trading among firms would be inherent in the system, since the number of permits would be limited to less than the current level of waste generated. The eventual value and distribution of permits would be set by the marketplace, with waste reductions coming from those firms that could reduce most cost-effectively. These firms would be able to sell any unused permits on the open market as "waste reduction credits." Moreover, since EPA would phase down the amount of waste generation allowed, the permits would increase in value over time, creating a continuous incentive to reduce waste further.

Phasedown permits would cost society far less than other performance standard options for achieving a given level of waste reduction if there are sufficiently wide variations in unit control costs among generators and if trades are actually made among firms. They do, however, raise novel implementation problems. Two concerns are the initial distribution of permits and the degree of trading to be allowed. However, these issues may be resolvable, as demonstrated by EPA's recent program to phase down the lead content of gasoline. A third concern is how to determine the rate of the phasedown and the amount of hazardous waste allowed at the end of the phasedown period.

Under any of these options, EPA would consider exempting small quantity generators from the requirements or would consider subjecting them to simplified and less burdensome requirements. Because small quantity generators collectively account for only a small fraction of the wastes generated annually,[8] subjecting them to stringent and expensive regulations may not be cost-effective or provide additional protection of human health and the environment.

Management Practices

Management practices, as defined in this report, are procedures or institutional policies within a service or manufacturing operation that result in a reduction in hazardous waste generation. They are a step beyond the directives established by performance standards and include requirements restricting particular disposal practices, requirements for the handling of wastes as they are generated, and requirements for controlling the waste generation system.

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[8] Small quantity generators regulated under RCRA are those who generate between 100 and 1,000 kilograms of hazardous waste per month. According to the *National Small Quantity Hazardous Generator Survey*, conducted for the Office of Solid Waste in 1985, small quantity generators, including those who generate less than 100 kilograms per month, collectively account for less than one half of one percent of the total quantity of waste generated annually.

Three management practices are discussed below. The first would ban the landfilling, treatment, or incineration of potentially recyclable wastes. The second would require the segregation of wastes to enhance recycling potential. The third would require mandatory waste audits.

Banning the landfilling, treatment, or incineration of potentially recyclable wastes would likely be controversial and possibly inefficient. In addition, while it would be possible to make sure that no proscribed waste is landfilled, treated, or incinerated, it would be exceedingly difficult to ensure that all such waste is properly recycled instead, thus making it difficult to enforce. Noncompliance (e.g., illegal dumping) would potentially be substantial.

A second possibility would be a requirement for segregation of waste streams and banning the mixing of waste streams that are potentially recyclable. This includes the isolation of hazardous materials from nonhazardous materials or the isolation of liquid from solid waste. The segregation of wastes does have the potential in selected instances to be economically attractive, and could, in fact, save some firms significant sums of money by reducing treatment and disposal costs, lowering expenses for the purchase of raw materials, and/or generating a reclaimed product that can be marketed or sent to a waste exchange. Waste stream segregation might, therefore, become economically attractive without additional regulation. It is conceivable that new prohibitions on land disposal and dramatically increased costs for all forms of disposal, coupled with substantial efforts to increase industry awareness of recycling possibilities, could provide adequate information and incentive for segregation without making such action a regulatory requirement.

Waste audits can be an effective means to identify opportunities for waste minimization, making audits mandatory, however, could undermine their effectiveness. While the direct costs of waste audits for industry are not extremely high (on average

$10,000 to $20,000 per audit for an uncomplicated facility)[9], requiring every waste generator to conduct an audit could have some detrimental effects. If they were seen as a Federal requirement rather than as a corporate initiative, plant personnel might tend to be less than forthcoming and the results of such audits often might be discounted and disregarded. A mandatory program might also require EPA to develop implementing regulations to address who is qualified to conduct waste audits and how audits should be conducted, and to monitor possible reporting requirements. Since it would be difficult to require compliance with the recommendations of a waste audit, such efforts do not seem justified.

It appears more desirable for EPA to promote voluntary waste audits on their own merits as a useful waste management tool, such as through a technical assistance program implemented through the States (see below). EPA and the States could develop programs that would include State certification and listing of qualified waste minimization auditors, targeted assistance programs for onsite audits, and development of model checklists and protocols for conducting audits. In the context of a voluntary audit approach, such programs should be less burdensome to develop and more flexible to implement than under a mandatory regime; thus, it is suggested as an EPA initiative.

Legislative Amendments to HSWA

EPA currently interprets the certification requirement under HSWA Section 3002 (generator standards) and Section 3005 (permit standards) as prohibiting the development of substantive requirements to generators on what constitutes appropriate waste minimization. As the Senate Report on the certification process emphasizes, the intent of the current requirement is merely to encourage generators to consider specifically the desirability and feasibility of waste minimization; it does not require specific waste minimization action.

The Agency believes that generators should continue to determine what their waste minimization options are and, at this time, that EPA should not make process related decisions to force waste minimization. However, EPA is further considering an option to amend the current legislation to allow EPA to define acceptable waste minimization practices. This authority could allow EPA to specify general practices that could or could not be certified as waste minimization (e.g., those practices that result in adverse cross-media pollution transfers). EPA is continuing to evaluate this change to the waste minimization certification statement, and will provide Congress a further assessment of the need to modify these requirements. Among possible options to consider include:

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[9] For smaller facilities, the costs could be substantially lower, perhaps under $5,000; however, for large, complex facilities, the costs could be substantially higher.

- Prohibit, where appropriate, certification of certain types of waste management practices as waste minimization.
- Specify what may be certified as waste minimization.
- Define necessary documentation for certifications that state that waste minimization is not economically practicable.

As additional information becomes available, the Agency could use this discretionary authority to focus on specific industries that continue to create potential risks to human health and the environment.

While small quantity generators might be subject to such additional reporting responsibilities under this option, EPA could consider subjecting them to less rigorous and burdensome requirements than those affecting large quantity generators.

Other Options

A number of other waste minimization options have been identified in the course of preparing this report. A full list of available options is found in the technical support document for this report, *Waste Minimization Issues and Options*. Several of the options listed there are not discussed here for various reasons: either they have been considered already under other authority (such as the provisions for a waste-end tax now under consideration as part of the CERCLA reauthorization), or they have been found, on further review, to be unworkable as part of RCRA (e.g., enforcement bounties). Appendix B to this report lists options that have *not* been evaluated or presented here and explains the reasons for their exclusion.

Two basic options for waste minimization that the Agency believes should definitely be considered as part of a short- or long-term waste minimization strategy are (1) technical assistance for waste minimization, implemented in cooperation with the States, and (2) modifications to Federal procurement practices to avoid discriminating against recycled commodities and, where appropriate, to support development of markets in recycled commodities.

An active, aggressive, and sustained program for technical assistance appears to be the strongest option available to promote waste minimization, especially in the near term. Carried out in cooperation with the States, such a program could be aimed primarily at small[10] and medium sized companies, which currently have the least access to information on how to minimize their wastes. The program's purpose would be to encourage firms to include waste minimization efforts in their hazardous waste management planning, to provide access to technical information, and to encourage the development of markets for recyclers and recycled materials. No new legislative authority would be required to launch such a technical assistance effort, but adequate and sustained support by Congress would be necessary over the next ten years if it were to achieve its potential.

RCRA already provides authorization for EPA to encourage revision of Federal procurement practices to promote the use of recycled products. Section 6002 of RCRA requires procuring agencies to amend Federal procurement practices to avoid unnecessary discrimination *against* recycled products, and requires EPA to promulgate procurement guidelines that actively promote the procurement of recycled products. This strategy may help achieve substantial increases in the market share of recycled products, particularly where the Federal government is a major consumer of a product. In such instances, a Federal preference for a recycled product may make the product economically viable. EPA should work with agencies that are in the best position to create such markets, including the Department of Defense and the Department of Energy.

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[10] "Small" companies are not intended to include only Small Quantity Generators as defined under RCRA. A technical assistance program would also be useful for small quantity generators, but the degree of emphasis on this group would have to be carefully reviewed. While small quantity generators do need (and often request) technical assistance, the available data suggest, as noted earlier, that they contribute only a very minor fraction (about one-half of one percent) of hazardous waste volume nationally.

Recommendations

At this time, the Agency believes that generators should continue to determine which waste minimization techniques are economically practicable and that EPA should not specify requirements for waste minimization.

If, after implementation of the other pertinent provisions of the HSWA, the Agency decides that standards of performance or required management practices are needed to protect human health and the environment, it will then request the necessary additional authority from Congress. EPA proposes to report to Congress on this issue in December 1990, the earliest date at which it believes a recommendation on the need for a mandatory waste minimization program could be made.

EPA does plan to expand its waste minimization efforts as discussed below in the context of EPA's proposed three-point waste minimization strategy.

The elements of this strategy are:

1. **Information Gathering:** Detailed data on industry's response to the land disposal restrictions program and other existing waste minimization incentives must be gathered in order to make a final determination on the desirability and feasibility of performance standards and required management practices.
2. **A Core Waste Minimization Program:** During the interval when the new provisions of HSWA are taking effect, EPA will launch a strong technical assistance and information transfer program through the States to promote voluntary waste minimization in industry, government, and the non-profit sectors of the economy. It will also work with Federal agencies to encourage procurement practices that promote the use of recycled and reclaimed materials.
3. **Longer Term Options:** Based on an analysis of the new data gathered under (1) above, performance standards and other mandatory requirements can be imposed, if necessary, once the

HSWA amendments have taken full effect and their impacts on waste generation have been assessed.

Information Gathering

Agency actions to encourage waste minimization, whether through voluntary means or through future regulatory action, must be based on a full understanding of the present state of hazardous waste generation and management and of how that system is evolving under the many pressures to which it is now being subjected. The general patterns and trends of hazardous waste management systems are becoming clearer, but past trends may not persist through the next four to six years as HSWA's new provisions take effect, and as industry seeks to control the potential financial liabilities associated with hazardous waste management.

Baseline and trends data: The best data available to the Agency on the amount and content of hazardous wastes were developed by surveys conducted in 1981 and 1983. These data are rapidly becoming out of date and are known to be of uneven quality because of reporting errors and the small and variable sample sizes from which information was extrapolated. They must be supplemented with new data documenting the changes that have already begun and will continue to progress over the next few years.

In order to make a final determination on the desirability and feasibility of mandatory waste minimization actions, the Agency must be able to document unresolved environmental problems for which such a new regulatory program would be the appropriate response. Examples might be waste streams for which treatment and disposal capacity remains inadequate even after the land disposal restrictions have been in place for a year or more, or a future EPA determination that a particular type of hazardous waste treatment method does not, in practice, adequately protect human health and the environment.

The types of data needed include detailed baseline information on the volumes and toxicity of wastes generated, trends data on source reduction and recycling, trends data on treatment and disposal capacity, and analyses of the human health and environmental impacts of treatment and disposal practices. EPA expects that existing statutory authority is sufficient to gather this additional data. One potential source will the biennial reports, which will be upgraded to improve the consistency and coverage of the information submitted. Other sources may include a new generator survey or the 1986 TSD survey currently being undertaken, information developed by EPA programs outside of the Office of Solid Waste (such as under TSCA), and the reporting requirements that may be enacted under amendments to CERCLA.

Data to support technical assistance and information transfer: Much of the same data can be used to set priorities for technical assistance programs to promote source reduction and recycling programs, targeting them where they will be most successful in reducing threats to human health and the environment. However, in-house research and cooperation with States and industry trade associations will provide more detailed information on the cost and effectiveness of specific waste minimization techniques for the targeted industries. This information gathering program will enable EPA to develop an accurate profile of waste management trends and practices and selectively develop performance standards or other requirements as needed.

A Core Waste Minimization Program

As this report has already emphasized, it is neither desirable nor practical to research, promulgate, and enforce a major regulatory program mandating specific waste minimization standards over the next four to six years. During this time, industry will be making technical and financial commitments to respond to the changing requirements and incentives of the hazardous waste management system. Once made, these commitments will be difficult to change. It is therefore both practical and highly desirable to conduct outreach programs to support and enhance the use of waste minimization as part of an overall waste management strategy and to reduce threats to human health and the environment. It should be noted that, in the event that mandatory controls are needed in the near term to control volume or toxicity of wastes generated by particular industries, EPA would use the authority that currently exists under Section 6 of the Toxic Substances Control Act.

Elements of this initial waste minimization program will include:

- Development and publication of an Agency policy statement on waste minimization including non-binding guidance to generators defining what constitutes waste minimization under the reporting and certification requirements of HSWA. To the extent possible, this guidance will be specific to particular industrial sectors and processes.

- Expansion of EPA's role in providing for technical and information assistance to generators, including small generators. Because the States have more direct contact with the generators and hence have more awareness of generators' needs and problems, EPA's primary role should be to support and encourage the States in the development of their programs. An appropriate EPA-sponsored technical assistance effort includes the following elements:

  - Assistance for States to initiate and develop programs for providing direct assistance to generators, especially small and medium sized generators.

  - Technical support of research and development and economic feasibility studies that might serve an entire region or have regional application.

  - Development of a computerized information system on waste minimization, accessible by the States.

- Encouraging voluntary waste minimization concepts within the review of new chemicals mandated under TSCA Section 5. EPA anticipates the preparation of a New Chemicals Information Bulletin advising submitters that waste minimization will be considered during the review of the relative risks of the new chemical substances and their existing substitutes.

The Agency should also establish a formal process of coordination with the States to ensure a continuing and responsive technical assistance and outreach effort over the longer term.

In addition, EPA will continue to examine specific elements of the "core" waste minimization program and make recommendations for legislative changes to the existing waste minimization requirements, if needed, as part of the next RCRA reauthorization. Among the possible options to consider would be modifications to the existing certification for generators and TSDFs, including:

- Prohibiting, where appropriate, certification of certain types of waste management practices as waste minimization.
- Providing, where appropriate, formal guidance as to what may be certified as waste minimization. Such guidance could apply generally or to specific industrial sectors. (Flexibility for appeals and exceptions must also be provided.)
- Requiring generators who have not undertaken any of the approved waste minimization activities, but who certify that there is no economically practicable alternative to their present waste reduction and management practices, to provide a written explanation of such certification.

Longer Term Options

Only after the land disposal restrictions and other principal provisions of the HSWA go into effect, and after EPA has developed the needed additional data on hazardous waste generation and management, will it be possible to determine whether standards of performance (including phasedown permits) or required management practices (such as waste audits) are necessary to achieve additional reductions in the volume or toxicity of wastes. The Agency therefore recommends that consideration of new mandatory programs be deferred until after such data can be gathered and analyzed, and proposes to report back to Congress on the desirability and feasibility of prescriptive approaches two years after the first of the land disposal restrictions has been fully implemented. Excluding the possibility of case–by–case extensions, the first of the land disposal restrictions will be fully implemented in November of 1988; EPA will, therefore, make its next formal report on this subject in December of 1990.

Conclusion

EPA still has much to learn about waste minimization and recognizes that the cooperation of private and public waste generators will be invaluable as it moves toward the development of sound long term policy. It also believes, however, that the incentives and trends within the hazardous waste management system are unmistakable, and that the program presented here comprises the most positive and constructive steps that can be taken at this time. Aggressive action in favor of waste minimization is clearly needed, but a major new regulatory program—at least for the present—does not seem desirable or feasible.

Incentives for waste minimization are already strong, so EPA must capitalize on them. Most lacking is access by generators to the information that will demonstrate the economic benefits of waste minimization to industry, overcome logistical problems, and help develop creative new approaches. This can be provided by a strong technical assistance and information transfer effort, which can achieve through voluntary means what would be inefficient and possibly counterproductive to attempt through regulation. Unfortunately, non-regulatory programs have often failed at EPA for lack of statutory or regulatory deadlines and institutional advocacy. For such a program to work, it must be given strong organizational support within the Agency.

EPA is willing to make this commitment, and seeks support from Congress to ensure its success.

Report to Congress on Minimization of Hazardous Waste

INTRODUCTION

This Report to Congress is submitted in response to the requirements of Section 8002(r) of the Solid Waste Disposal Act, as amended by the Hazardous and Solid Waste Amendments (HSWA) of 1984. Under this Section, the Administrator of the Environmental Protection Agency (EPA) is required to submit a Report to Congress by October 1, 1986, to recommend any legislative changes or regulatory measures that he considers feasible and desirable to implement HSWA's policy with respect to the minimization of hazardous waste, which states:

> The Congress hereby declares it to be the national policy of the United States that, wherever feasible, the generation of hazardous waste is to be reduced or eliminated as expeditiously as possible. Waste that is nevertheless generated should be treated, stored, or disposed of so as to minimize the present and future threat to human health and the environment.

Under Section 1003, Congress specifically mentions process substitution, materials recovery, properly conducted recycling and reuse, and treatment as waste minimization methods to be encouraged.

Section 8002(r) requires the Administrator to evaluate specifically the feasibility and desirability of:

1. Establishing standards of performance or of taking other additional actions under RCRA to require generators of hazardous waste to reduce the volume or quantity and toxicity of the hazardous waste they generate, and

2. Establishing, with respect to hazardous waste, required management practices or other requirements to ensure such wastes are managed in ways that minimize present and future risks to human health and the environment.

Section 8002 requires the Administrator to evaluate waste minimization options in the context of the additional requirements applicable to persons who generate, transport, or manage hazardous waste under the Resource Conservation and Recovery Act (RCRA). Principal areas of regulation under RCRA include (1) transport manifests, (2) biennial reports, and (3) the requirements for onsite treatment, storage, and disposal of hazardous wastes. The feasibility and desirability of making further changes to these requirements will also be addressed in this report.

Chapter One of this report provides background on the subject of waste minimization and on the various factors that are critical to its understanding and implementation. It reflects the Agency's thinking about why waste minimization is important, where various types of new initiatives might be undertaken, and what information remains to be collected and evaluated before the details of a long term strategy can be designed.

Chapter Two presents the data and information pertinent to developing a national waste minimization strategy. It begins with a profile of hazardous waste generation, highlighting the aspects of the data that are most pertinent to waste minimization. It continues with a discussion of the current status of waste minimization in industry and the States—how it is being done and what the incentives and barriers appear to be. It discusses current EPA activities in relation to waste minimization and in relation to other policies such as consideration of cross-media interactions. The chapter concludes with a discussion of current activities at EPA to encourage or conduct research into waste minimization.

Chapter Three discusses the options available to encourage more waste minimization through action at the Federal level. It begins with a presentation of the criteria by which the Agency has reviewed the desirability and feasibility of the identified options. The chapter then groups the available options into four categories, beginning with the three that Congress has directed EPA to address. The categories are: (1) performance standards, (2) legislative actions other than use of performance standards, (3) management options, and (4) options that do not fall into the first three categories.

Chapter Four presents the recommendations of the Agency. It discusses how various options from various categories of activities could fit together over the long term to form a comprehensive waste minimization strategy. It also describes the types of data that must be gathered before the long-term elements of a waste minimization program can be implemented.

Various appendices are attached to this report, providing more detail on the specific issues and options addressed in the main text. Appendix A provides a fuller discussion of the principal waste minimization options. Appendix B discusses options that had tentatively been developed as part of the technical support document for this Report to Congress, but which have been dropped for various reasons from further consideration. Appendix C reviews the history of OSW waste minimization activities. Appendix D discusses scoring methods used to estimate the toxicity of various hazardous waste streams as part of the background research for this document. Appendix E contains copies of all official correspondence signed either by the EPA Administrator or by the Assistant Administrator for Solid Waste and Emergency Response on the subject of waste minimization.

Chapter One

BACKGROUND

In 1976, the U.S. Environmental Protection Agency (EPA) issued a policy statement outlining its preferred hazardous waste management strategy.[1] That strategy, which favors source reduction and recycling over treatment and land disposal, has remained intact over the past decade despite comprehensive statutory amendments and substantial expansion of the hazardous waste program. The following, in descending order of preference, are the basic elements of this strategy.

1. **Waste Reduction:** Reduce the amount of waste at the source, through changes in industrial processes.
2. **Waste Separation and Concentration:** Isolate wastes from mixtures in which they occur.
3. **Waste Exchange:** Transfer wastes through clearinghouses so that they can be recycled in industrial processes.
4. **Energy/Material Recovery:** Reuse and recycle wastes for the original or some other purpose, such as for materials recovery or energy production.
5. **Incineration/Treatment:** Destroy, detoxify, and neutralize wastes into less harmful substances.

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[1] 41 FR 35050, August 18, 1976

6. **Secure Land Disposal:** Deposit wastes on land using volume reduction, encapsulation, leachate containment, monitoring, and controlled air and surface/subsurface water releases.

Waste minimization, as defined in this report, includes the first four categories of this hierarchy and can be seen as an essential element of Federal hazardous waste management policy. Congress, through the HSWA, has directly instituted several waste minimization actions, such as requiring hazardous waste generators to certify on their manifests that they have active waste minimization programs in place. Most important in the larger policy context, HSWA puts even further emphasis on waste minimization by making it the national policy with respect to hazardous waste management, similar in scope to the zero-discharge policy of the Clean Water Act or the non-degradation policy of the Clean Air Act.

This report responds to the HSWA directive to examine the desirability and feasibility of expanding the Federal role in waste minimization through the use of statutory changes, regulatory requirements, or other program initiatives. It interprets the broad mandate established under HSWA and describes how that mandate can best be carried out as an affirmative national program within the overall waste management strategy.

The following definitions are crucial to the discussions and recommendations made in this report:

- **Waste minimization** means the reduction, to the extent feasible, of hazardous waste that is generated or subsequently treated, stored, or disposed of. It includes any source reduction or recycling activity undertaken by a generator that results in either (1) the reduction of total volume or quantity of hazardous waste or (2) the reduction of toxicity of hazardous waste, or both, so long as such reduction is consistent with the goal of minimizing present and future threats to human health and the environment.

- **Source reduction** refers to the reduction or elimination of waste generation at the source, usually within a process. This is the type of waste minimization that most closely corresponds to the concept of "waste avoidance." Source reduction measures can include some types of treatment processes, but they also include process modifications, feedstock substitutions or improvements in feedstock purity, various housekeeping and management practices, increases in the efficiency of machinery, and even recycling within a process.

As used here, source reduction implies any action that reduces the amount of waste exiting from a process.

- **Recycling** refers to the use or reuse of a waste as an effective substitute for a commercial product, or as an ingredient or feedstock in an industrial process. It also refers to the reclamation of useful constituent fractions within a waste material or removal of contaminants from a waste to allow it to be reused.[2] As used here, recycling implies use, reuse, or reclamation of a waste after it is generated by a particular process. It, too, can involve various types of treatment to facilitate the recycling process.

Table 1-1 lists these and other formal definitions of various terms used throughout this report.

The Purpose of Waste Minimization

The focus of the RCRA program over the past ten years has primarily been on correcting the effects of years of mismanagement of hazardous wastes by bringing treatment, storage, and disposal facilities into compliance with national standards that are protective of human health and the environment. This policy has continued with the passage of HSWA, but the program's central emphasis is now shifting away from reforming land disposal practices and toward establishing a broad national reliance on waste treatment. Because of its potential for contamination of other environmental media (e.g., ground water), land disposal—even under strict control—is recognized as the least desirable method of managing hazardous wastes.

The move toward treatment is a major step forward, but is not a complete answer. Reforms in land disposal practices and installation of new hazardous waste treatment capacity are effective responses to managing this country's hazardous waste, but they do not attack the problem's underlying cause. Preventing the generation of a waste is the only way to *eliminate* risk rather than reduce it. In conjunction with a program that drives

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[2] The definitions of "recycling," "use or reuse," and "reclamation" appear in 40 CFR 261, as amended by 50 FR 663, January 4, 1985.

Table 1-1

Working Definitions of Waste Minimization and Related Terms

Waste minimization:	The reduction, to the extent feasible, of hazardous waste that is generated or subsequently treated, stored, or disposed of. It includes any source reduction or recycling activity undertaken by a generator that results in either (1) the reduction of total volume or quantity of hazardous waste or (2) the reduction of toxicity of hazardous waste, or both, so long as such reduction is consistent with the goal of minimizing present and future threats to human health and the environment.
Reduction of total volume or quantity:	The reduction in the total amount of hazardous waste generated, treated, stored, or disposed of, as defined by volume, weight, mass or some other appropriate measure.
Reduction in toxicity:	The reduction or elimination of the toxicity of a hazardous waste by (1) altering the toxic constituent(s) of the waste to less toxic or nontoxic form(s) or (2) lowering the concentration of toxic constituent(s) in the waste by means other than dilution.
Source reduction:	Any activity that reduces or eliminates the generation of a hazardous waste within a process.
Source control:	Any activity classifiable under source reduction with the notable exception of product substitution.
Product substitution:	The replacement of any product intended for an intermediate or final use with another product intended and suitable for the same intermediate or final use.
Recycled:	A material is "recycled" if it is used, reused, or reclaimed (40 CFR 261.1(b)(7)).
Used or reused:	A material is "used or reused" if it is either (1) employed as an ingredient (including its use as an intermediate) in an industrial process to make a product; however, a material will not satisfy this condition if distinct components of the material are recovered as separate end products (as when metals are recovered from metal-containing secondary materials) or (2) employed in a particular function or application as an effective substitute for a commercial product (40 CFR 261.1(c)(5)).
Reclaimed:	A material is "reclaimed" if it is processed to recover a usable product or if it is regenerated. Examples are recovery of lead values for spent batteries and regeneration of spent solvents (40 CFR 261.1(c)(4)).

mandatory hazardous waste treatment to the limits of available technology, there will be a continuing need for waste minimization as a central element in hazardous waste policy.

There are at least three general areas where waste minimization can play a key role:

- **Protecting human health and the environment:** Current environmental control programs are well designed to protect health and the environment, but they do so only to the limits of current knowledge. The existing programs set their priorities on only a subset of the substances of possible importance. Although there are some 60,000 chemicals in commerce, the Clean Air Act currently concentrates on fewer than 40 toxic pollutants, the Clean Water Act on 129, and RCRA on approximately 500. Chemicals of concern are recognized far more rapidly than the regulatory process can accommodate them.

  In addition, none of EPA's environmental programs can fully eliminate all the risks that they attempt to control.

  — Treatment technologies are never 100 percent efficient, and land disposal, with all its known problems, will continue to be necessary for the foreseeable future.

  — Unintentional transfers of pollution among environmental media remain a complex and imperfectly understood phenomenon and create difficult problems for the environmental programs to identify and resolve.

  — Compliance with regulations under any and all of the environmental programs will never be perfect, even with the most stringent enforcement programs; so violations—deliberate and accidental—will continue to be a significant and largely undocumented source of health and environmental risk.

- **Alleviating shortages of treatment and disposal capacity:** Over the next several years, HSWA mandates a dramatic phasedown in the disposal of all forms of hazardous waste in and on the land. Wastes that are still generated will be treated with the best available technology. This will severely strain existing national capacity for incineration, waste stabilization, and the wide range of other chemical, physical, biological, and thermal treatment technologies. Capacity may remain scarce even with high demand because of the difficulty of siting new hazardous waste management facilities. In addition, land disposal will still be needed to dispose of those wastes for the residues of treatment.

- **Overcoming market inefficiencies:** Although existing incentives for waste minimization are strong, both source reduction and recycling ultimately depend on technical and management information. This information is often difficult and expensive to obtain. While all industries seek to improve product yield from resource inputs, not all industries have access to the kind of engineering information that could allow them to minimize waste economically, and many generators interested in recycling wastes do not know where or how they can safely do so.

Waste minimization helps protect human health and the environment because it reduces the total amount of waste that is generated and managed, including those substances whose risks may not be currently recognized or adequately appreciated. Preventing the generation of wastes or reducing the use of potentially harmful substances in manufacturing processes also helps to ensure worker safety. Finally, waste minimization is a constructive approach to avoiding the risks of breakdowns in the waste management system—wastes not generated cannot be illegally disposed or emitted by faulty or inefficient equipment.

On the other hand, waste minimization does not automatically avoid problems associated with cross-media pollution shifts. To achieve its purpose, waste minimization, like other pollution control measures, must look comprehensively across all environmental media; reductions in hazardous waste must not be made at the expense of increases in air or water pollution. This is an issue of paramount importance to the Agency and Congress.[3] Programs that merely shift pollution from one place to another can lead to net increases in health and environmental damage; they may also be economically counterproductive, since corrective action measures may have to be taken in the future. Waste minimization programs must therefore be carefully designed to avoid cross-media transfers and to protect human health and the environment in the comprehensive sense. The need to design a waste minimization program that addresses both of these goals provides a framework for integrating the objectives of all environmental programs. Figure 1-1 provides some perspective on the complexity of the pollution management system under various Federal statutes.

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[3] One of the Congressional objectives with respect to hazardous waste, as stated in Section 1003(a)(5) of RCRA, is that "hazardous waste be properly managed in the first instance, thereby reducing the need for corrective action at a future date."

In addition to its intrinsic health and environmental benefits, waste minimization can be viewed as a long-term approach for relieving shortages of treatment, storage, and disposal capacity. The capacity to accept wastes diverted from land disposal will be especially limited over the next few years while new facilities are under construction.[4] Furthermore, land disposal will continue to be required in the foreseeable future, even if wastes disposed of on land are detoxified first. Since land disposal needs are cumulative, capacity will always be a problem. Finally, all forms of waste management—treatment or land disposal—must make provisions for industrial growth. By reducing per unit product generation rates, waste minimization can provide at least a partial answer to all these problems.

Finally, many of the waste minimization options under consideration in this report are aimed primarily at helping generators gain access to the information they need and often request. An expansion of Federal involvement in this aspect of waste minimization could go far toward increasing the efficiency and pace of industry's natural inclination to reduce waste generation.

Methods of Waste Minimization

RCRA wastes include a wide array of pollutants and waste streams not otherwise controlled by Federal environmental laws. They include listed wastes, which are specifically identified in the regulations as generic types or in relation to particular industrial processes (examples include spent solvents used in degreasing or still bottoms from distillation processes), as well as characteristic wastes, which are defined in terms of their inherent chemical and physical properties (toxicity, ignitability, reactivity, acute hazardousness, or corrosivity).

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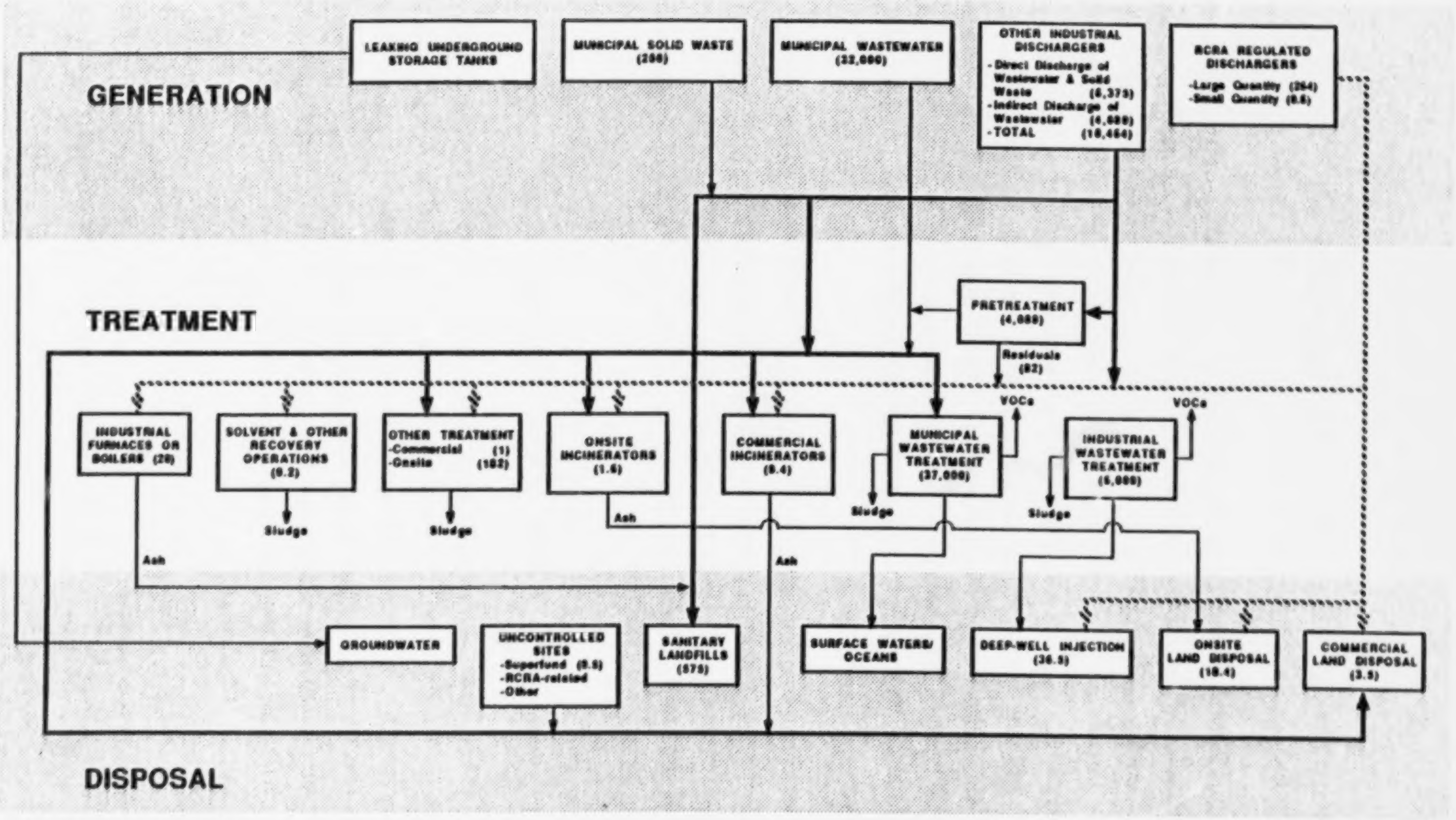
[4] This process may be slow, since public opposition makes new hazardous waste facilities extremely difficult to site.


GENERATION
LEAKING UNDERGROUND STORAGE TANKS
MUNICIPAL SOLID WASTE (208)
MUNICIPAL WASTEWATER (32,000)
OTHER INDUSTRIAL DISCHARGERS
-Direct Discharge of Wastewater & Solid Waste (6,373)
-Indirect Discharge of Wastewater (4,090)
-TOTAL (10,464)
RCRA REGULATED DISCHARGERS
-Large Quantity (264)
-Small Quantity (0.8)
TREATMENT
PRETREATMENT (4,090)
Residuals (82)
INDUSTRIAL FURNACES OR BOILERS (20)
SOLVENT & OTHER RECOVERY OPERATIONS (0.2)
OTHER TREATMENT
-Commercial (1)
-Onsite (182)
ONSITE INCINERATORS (1.5)
COMMERCIAL INCINERATORS (0.4)
MUNICIPAL WASTEWATER TREATMENT (37,000)
INDUSTRIAL WASTEWATER TREATMENT (5,080)
VOCs
VOCs
Sludge
Sludge
Sludge
Sludge
Ash
Ash
Ash
DISPOSAL
GROUNDWATER
UNCONTROLLED SITES
-Superfund (0.5)
-RCRA-related
-Other
SANITARY LANDFILLS (575)
SURFACE WATERS/ OCEANS
DEEP-WELL INJECTION (36.3)
ONSITE LAND DISPOSAL (18.4)
COMMERCIAL LAND DISPOSAL (3.3)

FIGURES INDICATE VOLUMES
IN MILLION METRIC WET TONS

FIGURE 1-1 SCHEMATIC DIAGRAM OF THE NATIONAL WASTE SYSTEM

In the broad context, HSWA recognizes three options for minimizing wastes—treatment, source reduction, and recycling. Whichever method is used, the end result must be a reduction in the volume, quantity, or toxicity of wastes generated and sent to land disposal. Policies to establish treatment requirements for hazardous wastes are already firmly established so, for the purposes of this report, we focus primarily on source reduction and recycling, which together make up the first four elements of EPA's hazardous waste management hierarchy. These are the areas where national policy is still evolving and where findings of the desirability and feasibility of specific options still need to be made.

Section 1003, which establishes the general national policy in favor of waste minimization, refers to the need to reduce the "volume or quantity and toxicity" of hazardous wastes, so as to minimize the "present and future threat to human health and the environment."[5] As used in this report, a reduction of total volume or quantity is taken to mean a reduction in the total amount of hazardous waste generated, treated, stored, or disposed of, as defined by volume, weight, mass, or some other appropriate measure. Reduction in toxicity implies a reduction or elimination of the toxicity of a hazardous waste by (1) altering the toxic constituents of a waste to less toxic or nontoxic forms or (2) lowering the concentration of toxic constituent(s) in the waste by means other than dilution.

Most waste streams are a mixture of hazardous and nonhazardous constituents, such as water, dirt, or nontoxic oils. This suggests that there is often an inverse correlation between toxicity and volume: all things being equal, as the volume of nonhazardous materials in a waste stream decreases (i.e., as a stream becomes less dilute), toxicity tends to increase. By calling for simultaneous reductions in both volume and toxicity, Congress expressed a clear desire to avoid defining dewatering and other processes which merely concentrate wastes as being primary methods of waste minimization.

EPA supports this Congressional concern, but also believes that Congress did not intend entirely to disqualify volume reduction by itself (with no change in toxicity) as a waste minimization technique. For example, EPA considers it beneficial if a firm can change its processes to produce less waste per unit product, even if the composition of the waste does not change. EPA also believes that waste concentration may occasionally be a useful approach to waste minimization, such as in relation to ameliorating shortages of land disposal or treatment capacity, or in preparing materials for recycling. The key concept is that waste minimization must enhance protection of human health and the environment.

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[5] HSWA Section 1003(b).

Thus, because both volume and toxicity of wastes are involved, measuring the effectiveness of waste minimization will be complex. First, waste minimization measures are likely to be process and industry-specific, implying that different measurement techniques might be needed in different contexts. Second, any mandatory requirements for reducing the volume or toxicity of generated waste should, ideally, relate directly to expected reductions in risk to human health and the environment. The measurement of risk reduction can be a very difficult task. EPA has, however, developed data and methodologies that can evaluate the risks of many types of waste streams, as well as the risk reductions associated with waste management practices. These evaluations will continue to improve and to provide valuable information as a tool in regulatory decision–making. The Agency would therefore use such assessments to help establish priorities among or within potential regulatory requirements that might be necessary to reduce waste generation further, and to help measure progress in waste minimization itself.

Waste minimization programs should ideally be designed with a view to ultimate protection of environmental quality and human health. In some cases, for example, it might make sense to concentrate wastes—even at the expense of increasing toxicity—if this volume reduction would make recycling more practical and economically attractive. In other cases, it might be desirable to increase waste volume if this would permit substantial reductions in toxicity or would aid in treatment.[6]

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[6] This particular trade-off is an accepted reality within the waste treatment program. Virtually all the technologies for immobilizing wastes increase waste volume substantially because they mix wastes with large amounts of fixing materials like cement or lime.

Incentives and Disincentives for Waste Minimization

Reduction of waste has long been a goal of EPA. This is, in fact, the third report to Congress on the general subject, the other two having been submitted in 1973 and 1974 regarding the reduction of nonhazardous "post-consumer" wastes such as glass, paper, tires, and obsolete automobiles. The existing incentives and disincentives for reducing hazardous and other industrial process wastes, however, are quite different from those affecting post-consumer wastes. Furthermore, the regulatory and economic environment within which wastes are managed has changed dramatically since 1974. The following pages describe current incentives and disincentives to waste minimization.

Incentives for Waste Minimization

Strong incentives already exist to promote waste minimization in the private sector, including (1) dramatic increases in the price of all forms of hazardous waste management, partially caused by Federal and State standards, (2) difficulties in siting hazardous waste management capacity, (3) permitting burdens and corrective action requirements, (4) financial liability of hazardous waste generators, (5) sharp increases in the cost of commercial liability insurance, coupled with a steep dropoff in its availability, and (6) public perception of industry's responsibilities to reduce the generation of waste. There are also countervailing disincentives.

Increases in the costs of hazardous waste management: EPA and State regulations have been the primary cause of increased costs in treatment, storage and disposal of hazardous wastes, especially in relation to landfills and surface impoundments. The HSWA has accelerated an already well-established trend toward higher costs for virtually all forms of hazardous waste management. Regulations upgrading design and construction standards for RCRA-approved landfills have already pushed the price of land disposal from as little as $10 to $15 per metric ton (in the early 1970s) to $240 per metric ton (for disposal in a RCRA-approved double-lined landfill). As opportunities for legal use of land disposal disappear, companies will turn to such technologies as incineration, which costs from $500 to $1200 per metric ton for organic wastes. Anticipated shortages in incineration capacity can be expected to drive its costs higher over the short term, and other treatment technologies are often considerably more expensive. These rising costs of land disposal and alternative technologies make waste minimization alternatives increasingly cost-effective.

The centerpiece of this policy is the land disposal restriction program, enacted to minimize the nation's reliance on land disposal—currently the primary method of managing hazardous wastes. This program is on a short and strict schedule: HSWA sets a series of dates banning continued placement of hazardous wastes in or on the land. These bans will be enacted in stages, beginning with solvents and dioxins on November 8, 1986, and continuing with liquid wastes containing high concentrations of hazardous metals (the "California List") on July 7, 1987. The remaining wastes will be banned by thirds, with successive "tiers" being banned in August 1988, June 1989, and May 1990.[7]

Although the effects of these regulations cannot be clearly predicted, the restrictions are expected to have a profound impact on waste management practices of generators as well as of treatment, storage, and disposal facilities. Disposal restrictions will limit the number of wastes that can be disposed of on land and will likely cause short-run capacity problems for particular generators while increasing the cost of waste management for all generators.

The extent to which generators will adopt waste minimization techniques to avoid the costs and difficulties of treatment and disposal will depend on the costs of alternatives that will satisfy the requirements of the land disposal restriction program, their access to capital, and their ability to change production processes to minimize the generation of regulated waste streams. A generator may not select a more efficient treatment technology, even though it exists, if the costs are too high. Facilities having adequate access to capital may be better able to cope with land disposal restriction impediments through research and development of innovative treatment technologies or further investment in existing treatments. But it is doubtful that, in the short run, many generators will be able to alter the character or volume of their waste streams significantly. While some generators might be able to reduce the concentration levels of the hazardous waste constituents themselves, and thereby avoid the earlier restriction deadline (e.g., the July 7, 1987, ban on California listed wastes), this strategy would only be effective on a temporary basis. The three final land disposal restrictions would eventually ban their wastes altogether unless adequate pretreatment were to be applied.

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[7] Waste streams within each tier were selected by ranking according to their volume and "inherent toxicological properties of hazardous constituents in the waste." For a ranking of the waste streams that will be prohibited see: *Documentation for the Development of Toxicity and Volume Scores for the Purpose of Scheduling Hazardous Wastes*, USEPA, Office of Solid Waste, March 28, 1985.

Of immediate concern to waste minimization policy is the severity of short-term impacts on those generators whose wastes are to be restricted. The earliest dates for land disposal restrictions cover solvents and dioxins. We might expect to see the first wave of innovative treatment in industries that generate the banned wastes. These include the paints, varnishes, lacquers, enamels, and allied products and pesticides sectors, where solvents are a major product constituent and are used to clean machinery after batch process manufacturing. The laundry, cleaning, and garment services sector also uses solvents in cleaning clothes. Because the industry has managed to develop a recycling process in which many firms participate, the restrictions are not expected to have a large impact. Sectors which have relied on land disposal for much of their solvent wastes will have to implement other means of waste treatment. Treatment technologies already exist for solvents; they include incineration, biological degradation and activated carbon adsorption.[8]

Though some of these treatments, such as incineration, are very efficient at solvent waste reduction, the costs have been prohibitive. Shifts in the demand for these treatments may now make them more economical. However, even if they do, temporary capacity shortfalls may make it difficult to handle the quantity of waste expected to be shipped to these treatment facilities.[9] In addition, facilities may use other treatments that are less expensive (e.g., air stripping), and which may merely shift solvents to another medium. Thus, such treatment may not ultimately reduce the hazards caused by the wastes.

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[8] *Analysis of Treatment and Recycling Technologies for Solvents and Determination of Best Demonstrated Technologies*, (Revised), USEPA, Office of Solid Waste, February, 1986.

[9] This is expected to continue as land restrictions increase the number of industries seeking other waste treatment methods. See: *Survey of Selected Firms in the Commercial Hazardous Waste Management Industry: 1984 Update*, USEPA, Office of Policy Analysis, September 30, 1985.

The July 7, 1987, deadline marks the second land disposal restriction date. The restrictions apply to the California List wastes, including those with high concentrations of metals, acids, corrosives, cyanides, and halogenated organic compounds. It is difficult to identify all the industries that will be affected by the California List disposal restrictions, since criteria for inclusion are based on waste stream concentration. Thus, some streams may not be restricted from land disposal at this time if the designated constituents do not exist in high enough concentrations. There are many generators of halogenated organic compounds, but it is unclear which ones will have waste stream loadings exceeding the 1,000 kg per month statutory ban level. In addition, other affected generators will probably include those having waste streams with particularly high concentrations of metals, such as the electroplating sector, the secondary smelting and refining industry, and the chemical manufacturing industry. Metal finishing firms generating concentrated acid wastes will probably also be affected.

Banning of the tiered waste streams, which include off-specification chemicals, residues from spills, and other relatively low-volume but often highly toxic materials, begins in August 1988. Waste stream restriction is based on descending order of toxicity and volume. An estimated 142 waste streams fall under the first tier, for a total annual volume in excess of 8.7 million metric tons. The higher toxicity of these streams will also increase the difficulty of treatment. Treatment capacity for managing these wastes is expected to become more limited as each successive tier is banned.

The limited market for treatment could have a long-term positive effect on waste minimization, because alternative treatment options may become increasingly costly. First, cost of waste treatment per unit volume will increase dramatically. RCRA regulations for land disposal facilities have more than doubled the cost of land disposal from under $100 per metric ton to about $240 per metric ton. Costs of alternatives like incineration and chemical treatment range even higher. Although these higher costs have already caused some generators to seek other methods for treatment and disposal, the actual land disposal restrictions on waste streams will probably cause even more impact on alternative treatment methods.

The HSWA amendments may also stimulate growth markets in most of the available treatment and disposal services, including incineration; chemical, physical, and biological treatment; and stabilization The question remains, however, as to how quickly and how much these services will add to the total national treatment capacity. Generally, assuming that market pressure will affect both generator and commercial treatment facilities equally (the former because their wastes are restricted and the latter because of the incentives to capture a larger market share), there could be a significant reduction in waste.

The expanded definition of small quantity generators (SQGs) includes a group of facilities that may be less able to comply with the restrictions than their larger counterparts. Rather than face the high costs of compliance with the more stringent disposal restrictions, some small quantity generators may illegally dump their wastes. Although the cumulative volume generated by this group is small, illegal dumping could be disproportionately dangerous since certain wastes generated by SQGs may include such highly toxic materials as pesticide residues and electroplating sludges.

There are, therefore, many uncertainties over how industry and other hazardous waste generators will react to the new system. It is clear that capacity for the kinds of treatment mandated under these rules is not currently sufficient to handle the volume of wastes that will be forthcoming, but it is not clear how quickly the marketplace can install more capacity to respond to the land disposal restrictions, and, when it does, what the cost will be. EPA has already identified shortages of treatment capacity for solvent and dioxin wastes in its proposed regulations.[10] For solvents, it estimates a shortfall of more than 73 million gallons per year for wastewater treatment capacity, and of 6.7 million gallons per year for incineration; for dioxins, it estimates that there are approximately 1.35 million metric tons of waste, with no approved treatment capacity available. It is also difficult to predict the possible increase in illegal disposal and nonreporting, although at least some increase is expected.

Most significant for the objectives of this report, the Agency does not know to what extent, and in what industrial sectors, further source reduction and recycling will occur voluntarily. Until further information becomes available, it will not be possible for the Agency to decide where there may be a need for further reductions in per-unit waste generation rates, reductions that could only be accomplished by some type of command-and-control regulation similar to the types of controls traditionally enacted by the other major EPA programs in air, water, drinking water, and toxic substances.

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[10] 51 FR 1729, January 14, 1986

Additional new management requirements are also increasing the cost of hazardous waste management. Under Section 3005(j)(1), existing surface impoundments will not be allowed to receive, store, or treat hazardous wastes after November 8, 1988, unless the impoundments are in compliance with the minimum technology standards applicable to new surface impoundments. This means they must be retrofitted with two liners, with a leachate collection system between the liners. The statute provides four exemptions from the retrofitting requirement; exemption applications for existing impoundments must be submitted by November 8, 1986.

Despite the availability of exemptions, the impacts of this program will be substantial. Not only is the retrofit process expensive and time consuming, the Agency expects that, in the process of renovation, many facilities will be found to have leaked hazardous constituents, making them subject to the corrective action provisions of HSWA (see below). Out of the 1,500 surface impoundments now operating, about one-half are expected to close permanently. This reduction in capacity is expected to increase the costs of managing the affected group of wastes significantly, and thereby provide another strong incentive for waste minimization.

Difficulties in siting hazardous waste treatment, storage, and disposal capacity: The land disposal restrictions program, as mandated by HSWA, is creating a strong demand for substantial new waste treatment, storage, and disposal capacity. Hazardous waste managers are therefore seeking new sites and planning to expand existing ones, but in the process they are encountering the familiar problem of "not in my community." While there are some instances where States have been successful in helping to site new hazardous waste management facilities, local resistance is extremely hard to overcome. This intense public opposition to the siting of many types of hazardous waste facilities may cause shortages to persist even when market demand is strong. Generators' only alternative in many cases may therefore be a reliance on source reduction and onsite recycling to reduce the amount of waste they would otherwise send to offsite management facilities.

Permitting burdens and corrective action requirements: Treatment, storage, and disposal facilities (TSDFs) must comply with extensive RCRA permit requirements. Although the demand for new capacity will be high, permit requirements will tend to delay substantially the availability of such capacity. The permit process usually takes several years to complete and is costly. Because these delays tend to drive up the costs of all forms of hazardous waste management temporarily and to limit overall treatment capacity, they will provide an additional short-term incentive for waste minimization.

In the course of applying for a permit, facilities may also face the corrective action provisions of HSWA Sections 3004(u) and (v). These subsections require that all permits issued after November 8, 1984, include provisions requiring corrective action for releases of hazardous wastes or constituents from any solid waste management unit (SWMU), regardless of the date the waste was placed in the unit. They also require that owners and operators take corrective action for releases both within *and beyond* property boundaries as necessary to protect human health and the environment. These potentially very expensive requirements apply to all facilities to which a RCRA permit is issued after November 8, 1984, including both existing and new facilities.

Even though the demand for new treatment and disposal will be high, permitting procedures will tend to delay the availability of that new capacity, temporarily driving up the costs of all forms of hazardous waste management. Increased costs of waste management provide a strong incentive for owners and operators to reduce the quantity of waste generated or disposed of through the use of all forms of treatment and disposal.

Financial liability of hazardous waste generators: A generator's decision to invest in either onsite recycling programs (which reduce the amount of wastes shipped offsite) or source reduction (which reduces the amount of waste generated) will depend in part on that generator's sensitivity to potential financial liability.

Waste management using offsite treatment, storage or disposal facilities puts a generator at risk in two ways: (1) there is a potential for mismanagement of the waste by the facility operators, and (2) there is the possibility of improper design of the treatment, storage or disposal facility itself, which could lead to releases of contaminant even if the facility is managed diligently. Even careful evaluation of both management and facility cannot reduce these risks to zero. Liability of the generator may arise when the TSDF owner or operator cannot or will not pay for remedial or corrective actions made necessary by migration of wastes. In these situations, generators can be held liable under common law theories of absolute, strict, joint, and several liability.[11] Under the provisions of CERCLA Sections 106 and 107, a generator can be held financially responsible for the entire cleanup or restoration of a facility to which it has sent wastes. This is an incentive for both source reduction and onsite recycling.

Shortages of liability insurance: The traditional means for reducing potential hazardous waste management liabilities is through the purchase of insurance. Generators of hazardous waste often obtain liability insurance as a prudent business practice, not because they are required to do so by Federal requirements. Unfortunately, over the past several years, the costs of all forms of commercial liability insurance available to generators and owners or operators of TSDFs have risen sharply, while the availability of liability insurance has been greatly reduced. Premiums have increased 50 to 300 percent, policies have been cancelled even where loss ratios have been excellent, and many companies have difficulty obtaining coverage at any price. This is particularly true of pollution liability coverage (environmental impairment liability (EIL) insurance), which until 1985 was a popular financial instrument used by generators and owners and operators of TSDFs to protect themselves from third party and government claims for damages resulting from environmental releases of hazardous substances.

The major reason for the current insurance capacity shortage is the insurance underwriting cycle. Traditionally, the insurance industry derives its profits from the investment of insurance policy premium income. During periods (such as the late 1970s to early 1980s) when profit from investment income increased (due to high interest rates), a highly competitive insurance industry accepted premiums that did not adequately reflect risks under the presumption that investment income would offset policy losses and still leave a substantial profit. As interest rates declined in the mid-1980s, investment income also declined, leaving insurers with insufficient income to offset insurance policy risks. As a result, the insurance industry incurred broad underwriting losses ($3.55 billion in 1984) in virtually all lines of liability coverage. During periods when insurers are incurring broad losses, capacity (i.e., investment in the insurance industry) decreases in all lines, but especially in those deemed high risk, such as pollution liability coverage. As a result, availability of these perceived high risk lines, including pollution liability, is insufficient.

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[11] Taken collectively, the practical interpretation of these terms is that a generator can be held liable for all damages associated with pollution that could possibly have been emitted from the facility, even if that emission cannot be documented, and even if other facilities may have contributed wholly or partially to the alleged exposure.

Pollution liability is considered to be high risk by insurers because of:

- A perceived lack of actuarial data and universally applied risk analysis methods to establish premiums that adequately reflect risk;
- Real and anticipated losses attributed to hazardous waste-related legal claims for damages against ambiguous insurer contracts, due to courts following the judicial precedent of interpreting ambiguities in insurance contracts against the drafter (i.e., the insurer);
- A social perception that hazardous waste has not been and cannot be adequately managed; and
- Resultant expanding tort liability for virtually all policies, a subsequent duty to defend those policies, and high legal costs and policy losses due to court rulings in favor of the insured for coverage that the insurer did not intend to provide.

The result of this situation is that many generators and handlers of hazardous wastes are vulnerable to potentially enormous financial liability. In addition, units at over 1,000 of the 1,551 land disposal facilities which have stopped receiving wastes under Section 3005(e) of RCRA lost interim status due to their inability to certify compliance with applicable financial responsibility requirements under RCRA. Many of the 5,600 owners and operators of TSDFs may be unable to comply with financial responsibility requirements against third party claims for sudden or accidental releases because new comprehensive general liability policies completely exclude pollution-related risks from coverage. The shortage or high cost of insurance will also affect 100,000 to 150,000 small quantity generators who must comply with RCRA regulations and may face potential strict, joint, and several liability under State common law and CERCLA.

As of February 1986, only one insurer in the pollution insurance market still offered insurance coverage for environmental pollution to facilities that do not maintain other forms of coverage with the insurer. The market has experienced major changes with respect to how companies employ risk transfer of their potential pollution loss exposure through insurance. More companies and their risk managers are retaining the costs of their potential pollution exposures because they are finding the general liability and, specifically, pollution liability insurance unavailable and unaffordable because of high premiums, high deductibles or self insured retentions, and restrictive policy language. Small quantity generators and medium and large quantity generators alike have experienced the same increases in insurance premiums. Small quantity generators, however, have been finding it increasingly difficult to afford insurance because they often lack the financial flexibility and resources typical of larger generators.

In order to insure themselves against liability, TSDFs who must comply with RCRA provisions regarding liability coverage[12] have resorted to creative methods to obtain coverage.[13] New instruments under development include: (1) formation of associations—captive stock or mutual insurance companies, (2) licensed carrier fronting programs for trust funds in which banks hold funds to cover liability, (3) letters of credit, and (4) self insurance (e.g., financial test). Still, generators and TSDFs will continue to have tremendous difficulty meeting pollution insurance requirements until fundamental changes occur in the insurance marketplace. Perhaps one of the main changes that will have a beneficial effect is a return to risk-based insurance, which should encourage waste minimization, instead of the current attempt by insurance companies to recoup losses they have incurred from cash-flow based underwriting in which they participated when interest rates were extremely high in the early 1980s.

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[12] Sections 3004 and 3005 (e) of RCRA. Under 40 CFR 264.147(a) and (b) as amended by 51 FR 25354, July 11, 1986, owners and operators of hazardous waste treatment, storage, or disposal facilities must demonstrate financial responsibility for bodily injury and property damage arising from both sudden and accidental and nonsudden accidental occurrences. For sudden and accidental occurrences, they must maintain liability coverage of at least $1 million per occurrence and $2 million per year aggregate, exclusive of legal costs. For nonsudden occurrences, they must demonstrate financial responsibility of at least $3 million per occurrence and $6 million annual aggregate, exclusive of legal costs; this can be demonstrated through liability insurance, corporate guarantee, or a combination of the two.

The net effect of this insurance shortage and its possible continuation for several years with no predictable resolution has exerted pressure on industry to reduce hazardous waste generation. In some instances, firms have already initiated source reduction and alternative waste management practices as a direct response to their having to accept increased uninsured liability. While specific information on these responses is difficult to obtain, major companies are known to have substituted material inputs and changed production processes in order to reduce the quantity of waste they generate. Action by large companies (who can better afford the research and retooling necessary to minimize wastes) has been faster than that of small companies, as overall waste generation on a per unit output basis has dropped significantly since the mid-1970s.

Increases in insurance costs or an inability to obtain insurance will result in higher treatment and disposal costs or the loss of available treatment or disposal capacity. This will provide a strong incentive to reduce the quantity of waste to be disposed of through the application of source reduction and onsite recycling techniques.

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[13] Currently, generators are not required to have liability coverage under RCRA unless they are treating, storing or disposing of wastes onsite. The liability coverage requirement does not, however, apply if the generator's treatment and/or storage is in a tank or container for less than 90 days. A proposed regulatory change published in 50 FR 33902 (August 1, 1985) suggested several alternatives for demonstrating financial responsibility, including (1) maintaining existing financial requirements, (2) requiring additional mechanisms for demonstrating financial capability, and (3) waiving or suspending the current financial requirements altogether. EPA has recently published an interim final rule that will allow TSDFs to use a corporate guarantee to satisfy their liability coverage requirements (51 FR 25350, July 11, 1986). Furthermore, EPA has established a work group which is considering more rulemaking in this area, as suggested by 50 FR 33902, August 21, 1985.

Public perception of company responsibilities: While the strongest incentives for reducing waste generation are undoubtedly economic, many companies are setting up waste minimization programs out of sensitivity to public concern over toxic chemicals. This type of corporate good citizenship is perceived to have long-term benefits for good relations between plants and local communities, as well as between companies and the general public. Although the larger companies are most likely to recognize public relations benefits in waste minimization, some medium and small-sized companies are also responding to public interest.

Barriers to Waste Minimization

Despite the downward trend in hazardous waste generation, the following general factors tend to discourage waste minimization programs in industry and elsewhere. They must be recognized and dealt with appropriately in developing a Federal waste minimization program.

Economic barriers: Although waste minimization practices often lead to cost savings, availability of capital for plant modernization to upgrade plants is often a significant obstacle to their implementation. Projects for waste minimization must overcome internal hurdles for project funding. The benefits from waste minimization are highly dependent on the probability and costs of hazardous waste releases and attendant cleanup costs; other company projects are often competing for funding that offer higher, more predictable, and more immediate returns on investment. Although major companies usually have sufficient access to capital to upgrade inefficient processes, small and medium-sized companies often do not. Nevertheless, such small companies could, in the aggregate, generate large amounts of hazardous wastes. Specialty chemical companies, agricultural chemical formulators, and metal finishing plants are examples of sectors dominated by smaller firms, which nevertheless produce significant volumes of highly toxic wastes and whose access to capital is limited.

Where capital is readily available, industries and plants within industries follow predictable business cycles in production investments. Firms that have recently modernized their facilities could perceive limited incentives to reinvest in alternative processes until their current plant is amortized and requires modernization. Operating costs and other financial burdens (such as reporting requirements) could also tend to discourage investment in waste minimization. These factors can be less important where waste minimization provides cost savings—as it frequently will—but in other situations, they will discourage action.

Financial liability can, in at least one circumstance, also be a significant disincentive for waste minimization. When generators make use of offsite recycling, they are liable under CERCLA and common law for damages caused by their wastes, even if there is no demonstration of negligence by the generator, and even when the wastes are no longer under the generator's control. This concern should, however, be weighed against potential liabilities surrounding the alternatives for managing this waste.

Technical barriers or considerations: There are practical limits to waste minimization, especially with respect to source reduction. Certain products simply cannot be manufactured without producing hazardous wastes, since some chemical process reactions produce residuals. Excessive waste minimization requirements could, in such cases, remove products from the market or put companies out of business entirely. A hazardous waste analog to the zero discharge policy, calling for across-the-board cuts of fixed percentages in waste generation, is therefore probably not realistic; in some situations, possible source reductions may turn out to be minor and achievable only at great expense. The law of diminishing returns suggests that the most easily effected and cheapest reductions may often be the most significant; additional incremental expenditures on waste reduction are likely to produce fewer and fewer results and at progressively higher costs.

While performance standards can play a constructive role in forcing the development of more environmentally sound technology, such standards can also produce perverse effects. An instructive example is seen in the printing industry, where the imposition of regulatory deadlines forced abandonment of research into new water-based inks, in preference to adoption of incineration of solvent-based inks. Targets and timetables for technology-forcing regulations would have to be carefully defined.

Another technical consideration in waste minimization is that industries producing high volume or high toxicity wastes often operate largely through batch processes, where waste minimization potential varies considerably among product lines and within the same plants in different phases of their production cycle. This is especially true, for instance, of the chemical and petrochemical industries. A source reduction measure must make sense within the process schedules that produce complex sequences of wastes and may be critically affected by the timing of waste production.

Source reduction measures must also be viewed in conjunction with potential for treatment, because wastes produced by a given process may be comparatively easy to treat or destroy, yet quite difficult to minimize through source reduction or recycling. Organic wastes, for example, are usually easy to incinerate, yielding destruction efficiencies of 99.99 percent or greater. It may therefore make little sense to require minor percentage reductions on waste generation when the remaining waste can or will be almost totally destroyed through treatment, or may be profitably recycled.

Similarly, recycling is often technically limited by process realities and recycling logistics. Off-specification chemicals (such as pesticides or pharmaceuticals) are examples of products with little recycling potential. Even where wastes are technically recyclable, it may be difficult to accumulate enough waste onsite to make the process economically attractive. With respect to offsite recycling, it may be hard to establish permanent and stable relationships among generators; generator and user processes have to be synchronized, purity may vary over time, volumes of waste available may not meet minimum recycler needs, transportation costs have to be acceptable, and price variations in feedstocks and in product prices inevitably play an important role, i.e., the virgin material could be less expensive than the recycled product.

Regulatory barriers: Some of the provisions of RCRA and other environmental statutes may tend to inhibit generators from pursuing waste minimization. Examples include the following:

- Source reduction sometimes requires the installation of new machinery that can, under RCRA, be considered "treatment." This in turn could require a generator to obtain a permit as a treatment, storage, and disposal facility (TSDF), a process that is expensive and generally requires two years to complete. In addition, HSWA Sections 3004(u) and 3004(v) require permitted facilities to conduct corrective action to clean up any contamination that could have previously migrated from their facility. Facing such time delays and expense, plants may prefer to pay for offsite treatment and disposal rather than attempt source reduction.

- The new definition of solid waste, promulgated by EPA to eliminate loopholes in RCRA controls and inhibit unsafe (or "sham") recycling, brings more wastes into the hazardous waste system. This definitional change seems to be inhibiting some plants from sending these wastes for recycling, because many companies believe manifested wastes present greater financial liability for offsite activities out of their immediate control.

- Commercial recycling facilities that wish to increase their operations might be reluctant to do so if the expansion were to require a revision of their NPDES water pollution permit to authorize a change in the composition of their discharges or allow for larger flows.

The Outlook for Federal Waste Minimization Policy

Although waste minimization policy is interwoven with general issues of waste management, waste minimization is ultimately a separate concept. Waste management deals with wastes after they are created; waste minimization deals with avoiding the generation of wastes altogether. At this stage of RCRA's development, the two ideas are often perceived as alternative methods for protecting human health and the environment, but, in the long term waste, minimization must take on a priority of its own.

EPA still has much to learn about the specifics and potential of waste minimization, and is only beginning to develop an active strategy for studying and promoting it. This report is, however, timely because it raises basic issues about the nature, direction, and methods of environmental policy at a time when options are still open. Because the data are insufficient and because it is still too soon to assess the effects of HSWA requirements, EPA can do little more in this report than to suggest the principal issues of concern.

Nevertheless, the Agency does believe that the recommendations made on the basis of the presentations in the next two chapters are the most positive and constructive steps that it can take at this time.

Chapter Two

EXISTING WASTE MINIMIZATION ACTIVITIES

The purpose of this chapter is to present the information that EPA has reviewed in developing this Report to Congress. It draws extensively on the technical support material developed for this report, *Waste Minimization Issues and Options.*[1]

The chapter begins with a profile of hazardous waste generation in the United States, discussing the volume and toxicity of wastes generated by different categories of industry and commenting on trends. It continues with a discussion of current technical approaches to waste reduction and recycling. The third section describes activities of the States in facilitating waste minimization through mandatory and voluntary programs. The final section of the chapter reviews EPA's existing activities in support of waste minimization.

Profile of Current Waste Generation

In characterizing current hazardous waste generation for the purposes of developing waste minimization policy, the following factors are most important:

- Waste quantities or volumes contributed by various industrial sectors;
- Waste toxicity;

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[1] *Waste Minimization Issues and Options*, Vols. 1 - 3, USEPA, Office of Solid Waste, Washington, D.C., October 1986.

- Relationships between waste streams and the industries that generate them (type, size, number of facilities); and
- Special issues for small quantity generators (SQGs).

The presentations in this chapter are drawn from four major studies of hazardous waste generation: (1) a mail survey of hazardous waste generators conducted by EPA in 1981 as part of the regulatory impact analysis (RIA) for RCRA,[2] (2) a study of hazardous waste generation by the Congressional Budget Office (CBO) based on surveys completed in 1983,[3] (3) the waste stream data base compiled from secondary sources in 1984 for use in the RCRA Risk-Cost Analysis Model,[4] and (4) the EPA 1985 survey of small quantity generators.[5]

EPA has found that significant inaccuracies exist in the two principal national level studies examined for this report. First, the age of the available source data reduces the reliability of the derived statistics. Economic factors, environmental regulations, and changes in manufacturing processes are known to have altered the quantity and quality of waste generated over the past five years; these changes have not yet been documented. Second, the source data suffer both from reporting errors and from the inherent difficulties of accurately characterizing the wastes.[6] Third, all the studies have extrapolated sample findings to the country as a whole; inaccuracies can therefore exist because of limited sampling sizes.

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[2] *National Survey of Hazardous Waste Generators and Treatment, Storage and Disposal Facilities Regulated Under RCRA in 1981*, USEPA, Office of Solid Waste, Washington, D.C. 1984.

[3] *Hazardous Waste Management: Recent Changes and Policy Alternatives*. Prepared for Senate Committee on Environment and Public Works, Congressional Budget Office, 1985.

[4] *The RCRA Risk-Cost Analysis Model: Phase III Report — Appendix A*. USEPA, Office of Solid Waste, Washington, D.C., 1984. This data base includes some streams that currently have no RCRA codes, but that meet the classification requirements of hazardous wastes. They are included for the sake of completeness and, therefore, offer a somewhat fuller picture of hazardous waste generation patterns than is shown by the CBO and RIA studies.

[5] *National Small Quantity Hazardous Waste Generator Survey*, USEPA, Office of Solid Waste, Washington, D.C., February 1985.

[6] Wastes with a particular waste code may vary significantly in content over time, from plant to plant and from industry to industry, making it very difficult to establish a "typical" content for any waste.

In all of these studies, industries are identified by Standard Industrial Classification (SIC) codes, down to the four-digit level.[7] Use of the SIC classification code system for defining industrial sectors is less than ideal for defining waste generation, since it usually lacks the detail necessary to link individual wastes with individual processes.[8]

Analysis of Waste Volume

To date, EPA has classified 207 separate hazardous waste streams, originating from 33 industrial sectors. Estimates for the total amount of hazardous waste generated annually range between 158.2 and 266 million metric tons, depending on the study used.

Figure 2-1 illustrates the contributions of the largest generators as described by (a) the Congressional Budget Office (CBO) Survey based on the 1983 data set and (b) the RIA Mail Survey, based on 1981 data. In both surveys, four broad industrial sectors (as defined by two-digit SIC codes) dominate. In the CBO survey, these are chemicals and allied products, primary metals, petroleum and coal products, and fabricated metal products. In the RIA Mail Survey, the high-ranking sectors are chemicals and allied products, machinery (except electrical machinery), transportation equipment, and motor freight transportation. Other sectors collectively contributed only a small fraction of the wastes generated by the largest four.

The disagreement between the two surveys on the identity of the major generators is significant and underscores the caution necessary in developing waste minimization policy. The differences can be attributed partly to the different years in which the samples were

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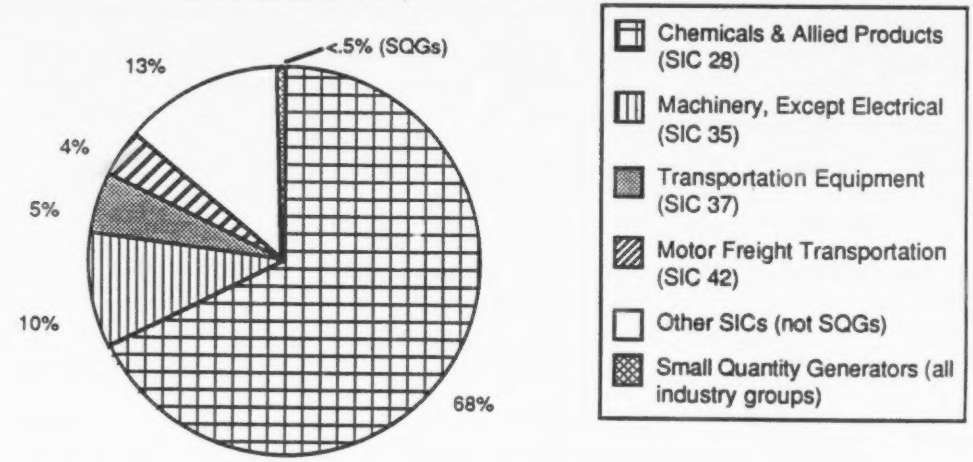
[7] The Standard Industrial Classification (SIC) system identifies establishments by types of activity. Establishments are grouped together if they exhibit similar industrial characteristics. Within a general two-digit SIC category, there are more detailed three- and four-digit categories. Four-digit SIC codes (under a general two-digit heading) group all establishments primarily engaged in the same kind of economic activity.

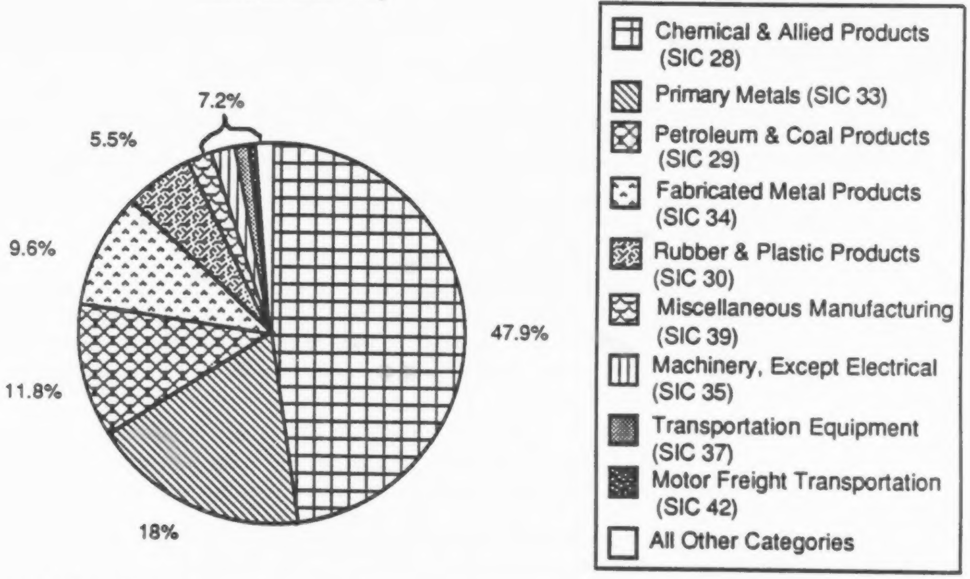
[8] While the SIC system is highly useful for making links with some other types of information, it may be desirable in the future to look also at the more process-oriented Source Classification Codes (SCC), since they specifically identify the processes that generate waste streams. Source Classification Codes (SCC) have been developed by the EPA Office of Air Quality Planning & Standards (OAQPS) for their Aerometric and Emissions Reporting Systems (AEROS). SCCs identify production processes within an industrial operation based on equipment type, fuel type, product, capacity, etc.

Figure 2-1
Industry Ranking by Hazardous Waste Generation

—A—
Industry Ranking by Hazardous Waste Generation, Based RCRA Mail Survey



—B—
Industry Ranking by Hazardous Waste Generation, Based on CBO Study



Sources: Office of Solid Waste, 1984, *National Survey of Hazardous Waste Generators and Treatment ,Storage and Disposal Facilities Regulated Under RCRA*, USEPA; Congressional Budget Office, May 1985, *Hazardous Waste Management: Recent Changes and Policy Alternatives*, The Congress of the United States.

taken and partly to differences in each study's definition of "hazard" and applied classification schemes. As noted above, sampling and reporting errors may also be important. More current data are clearly needed.

One fact on which all available data agree, however, is that the chemical industry (SIC 28: Chemicals and Allied Products) alone contributes far more hazardous waste than any other industrial sector: 47.9 percent as measured by CBO, 68 percent as measured by the RIA Mail Survey. Another area of general agreement is that small quantity generators collectively contribute only a small amount of hazardous waste—approximately 0.5 percent of hazardous waste by volume, according to the 1985 Small Quantity Generator (SQG) survey.

Aggregate figures for two-digit SIC codes comprise the contributions of many different individual waste streams which themselves vary widely in size. Patterns of waste generation within industrial sectors are similar to patterns across industrial sectors—a few waste streams tend to dominate the profile of each sector, with the volumes of the remaining streams decreasing dramatically. Table 2-1 shows total volume for each sector as shown in the RCRA Risk-Cost model data base. The recurrent pattern, potentially significant for minimizing waste volume and easing burdens on treatment capacity, is that the majority of waste volume is contributed by a small number of streams. In fact, if hazardous waste streams are viewed in descending order of volume across all industries, it is clear that the great majority of waste volume comes from a small fraction of the total number of streams, as shown in Figure 2-2. Note that the range of even the first 100 ranking streams is very large, spanning from 24 million metric tons per year[9] down to 5,800 metric tons per year.

Analysis of Waste Toxicity

In defining waste minimization, HSWA specifically refers to reducing both the volume and the toxicity of hazardous wastes. This is appropriate, since impacts on human

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[9] The highest volume ranking stream listed in the RCRA Risk/Cost Analysis Model data base happens to be a dilute wastewater from the explosives manufacturing industry; it is included in the data base because it contains explosive, rather than toxic, materials.

Table 2-1
Waste Stream Volumes for Highest Volume Generators

Industrial Sector	RCRA Code*	Volume (metric Tons per year)	Percent of Total Volume
Chemicals and Allied Products	Characteristic	24,000,000	50%
	Characteristic	8,172,000	17%
	Characteristic	5,448,000	11%
	K011	3,181,000	7%
	Characteristic	1,398,300	3%
	Characteristic	742,100	2%
	Characteristic	486,000	1%
	K009	399,500	1%
	Characteristic	388,000	1%
	K104	332,070	1%
	Characteristic	291,500	1%
	Characteristic	190,600	0%
	Characteristic	187,000	0%
	Characteristic	172,500	0%
	Characteristic	160,000	0%
	P029	151,222	0%
	Characteristic	136,200	0%
	Characteristic	118,000	0%
	K027	107,900	0%
	K022	106,200	0%
	Characteristic	101,700	0%
	Characteristic	96,200	0%
Remaining 136 streams		1,111,676	2%
Totals:	158	47,568,468	100%

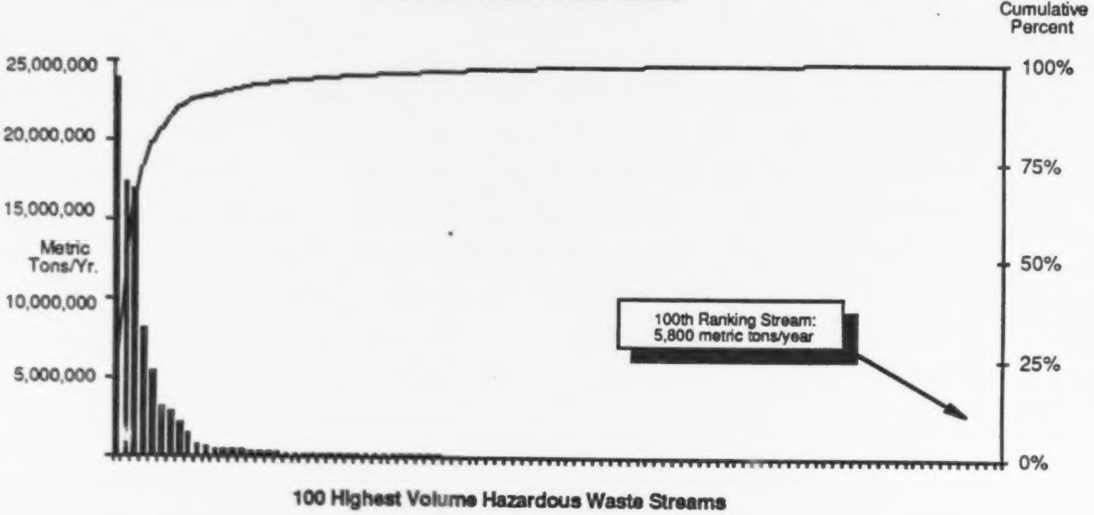
Industrial Sector	RCRA Code*	Volume (metric tons per year)	Percent of Total Volume
Primary Metals	Characteristic	16,915,102	72%
	K062	2,950,000	13%
	Characteristic	2,139,100	9%
	Characteristic	640,000	3%
	Characteristic	153,300	1%
	K100	139,500	1%
	Characteristic	85,400	0%
	Characteristic	83,600	0%
	Characteristic	72,200	0%
	K060	72,000	0%
	K061	70,000	0%
	Characteristic	60,000	0%
	Characteristic	42,000	0%
	K087	39,800	0%
	Characteristic	32,800	0%
	Characteristic	30,000	0%
	K069	28,600	0%
	Characteristic	16,000	0%
	Characteristic	11,000	0%
	Characteristic	8,000	0%
	Characteristic	500	0%
	F012	190	0%
Totals:	22	23,589,092	100%

Industrial Sector	RCRA Code*	Volume (metric tons per year)	Percent of Total Volume
Petroleum and Coal Products	K048	297,600	28%
	Characteristic	263,900	25%
	K051	196,200	18%
	Characteristic	154,700	14%
	K049	92,400	9%
	Characteristic	40,300	4%
	Characteristic	20,600	2%
	K052	7,100	1%
	K050	1,700	0%
	Characteristic	1,000	0%
Totals:	10	1,075,500	100%
Fabricated Metal Products	Characteristic	17,300,000	97%
	F006	488,400	3%
	Characteristic	30,700	0%
	F007	1,990	0%
Totals:	4	17,821,090	100%

* Waste streams labeled "Characteristic" are hazardous wastes under RCRA definition of Characteristic Wastes

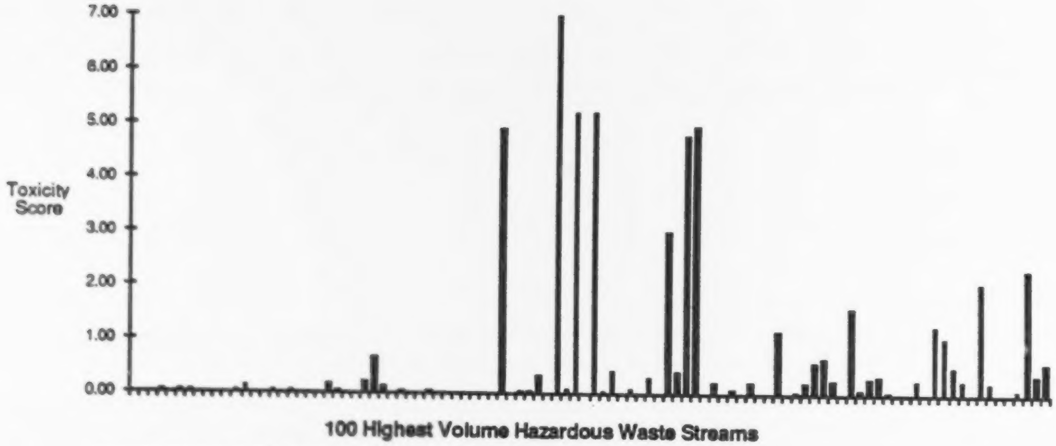
Source: Office of Solid Waste, March 1, 1984 "The RCRA Risk-Cost Analysis Model Waste Stream Data Base," USEPA.

Figure 2-2
Hazardous Waste Stream Volume



Source: Office of Solid Waste, March 1, 1984, The RCRA Risk-Cost Analysis Model Waste Stream Data Base, USEPA.

Figure 2-3
Hazardous Waste Stream Toxicity Scores:
Descending Order of Waste Stream Volume



Sources: Data from the RCRA Risk-Cost Data Base, with the EPA toxicity ranking developed for the land disposal restriction program schedule.

health and the environment are not simply a function of the quantity of a hazardous waste produced (which relates at least indirectly to public exposure), but also of its toxicity. The relative toxicity of hazardous wastes will therefore be important in setting priorities for waste minimization.

For the purposes of illustration, this report provides an indication of the relative toxicity of various wastes through use of a simple scoring approach that takes into account both the concentration of hazardous constituents within each waste and the estimated potency of the constituents with regard to adverse human health effects.[10] Estimates of the concentration of constituents in various waste streams are available from the data base developed for the RCRA Risk Cost Analysis Model; toxicity scores for the main constituents found in these wastes have been developed for setting the land disposal ban schedule.[11] These two sets of data have been combined to estimate toxicity scores for various wastes.

In Figure 2-3, the results of this scoring technique are applied to the 100 highest volume streams listed in Figure 2-2 to demonstrate that hazardous waste streams vary widely in their toxicity. Many high volume wastes are diluted with large amounts of water, soil, or other nonhazardous materials and, therefore, exhibit low toxicity scores. Conversely, many low volume wastes may be highly concentrated with toxic materials; discarded off-specification chemicals are an example of low-volume, potentially high-toxicity wastes. While there are many significant exceptions, it is often the case that the volume and toxicity of individual streams are inversely correlated—the higher the toxicity of a stream, the lower its volume is likely to be, and *vice versa*.

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[10] For a more complete discussion of the difficulties of measuring toxicity and documentation of the derivation of the toxicity scores used here, see Appendix D.

[11] The methodology for development of the toxicity scores used here is documented in *Documentation for the Development of Toxicity and Volume Scores for the Purpose of Scheduling Hazardous Wastes*, USEPA, Office of Solid Waste, Washington, D.C., March 28, 1985.

This point is important since, in many cases, HSWA's goal of toxicity and volume reduction may turn out to be in conflict, at least for setting minimization priorities.[12] Policies that focus on reducing the overall volume of hazardous wastes may not necessarily be best from the point of view of protecting human health and the environment. On the other hand, if the overriding priority in waste minimization is to lower burdens on treatment capacity, the Agency might want to focus on a different set of waste streams than if the main goal is to reduce high toxicity streams.

Patterns of waste volume and toxicity applying to broad, two-digit industrial groups appear to be repeated within individual sectors within the industrial group. Table 2-2 examines patterns of waste volume and waste toxicity for three four-digit industrial sectors: industrial organic chemicals (SIC 2865), pesticides and agricultural chemicals (SIC 2979), and petroleum refining (SIC 2911). It compares waste streams in terms of classes of toxicity and volume so as to show them on comparable scales. Class 10 implies the highest tenth in volume or toxicity of all wastes generated nationally; Class 1 implies the lowest tenth in volume or toxicity.

It is unwise to pursue this type of scoring very far at this time, since the data on which it relies are uncertain and the toxicity scoring algorithm used can yield only the most approximate idea of relative hazards. Nevertheless, this exercise does provide insight into the difficulties of estimating the ultimate human health and environmental risks of different hazardous waste management practices. It underscores the assumption that wastes vary widely in both toxicity and volume and that there are no consistent patterns across all wastes or industry sectors. It emphasizes the importance of developing better industry-specific and waste-stream-specific data, and the need to set waste minimization priorities carefully and deliberately with regard to specific waste management goals. Actions may be very different depending upon whether the goal of waste minimization is to relieve capacity shortages, reduce risks to human health or the environment, or minimize economic inefficiencies.

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[12] Yet another point to note is that toxicity is not the controlling consideration for listing all hazardous waste streams. According to the RCRA Risk/Cost Analysis Model Data Base, for instance, the highest volume stream identified turns out to be hazardous because it contains large amounts of nitrocellulose, and it is treated as hazardous because it is explosive rather than toxic.

Table 2-2
Comparison of Waste Streams for Three Industry Categories

Industrial Sectors	RCRA Code	Toxicity Rank*	Volume Rank*
Industrial Organic Chemicals (NEC)	K030	10	7
	K020	10	7
	K018	10	7
	K019	10	8
	K095	10	7
	K096	10	6
	K029	10	6
	K021	10	5
	K016	9	6
	K017	9	6
	K010	9	7
	P016	9	4
	K026	9	6
	U078	9	10
	U080	9	7
	U209	9	6
	U211	9	4
	U044	9	5
	U043	9	5
	U208	9	5
	U128	9	5
	U228	9	5
	U131	9	4
	U227	9	3
	U077	9	2
	U084	9	5
	U083	9	4
	P023	8	5
	U045	8	5
	U081	8	5
	U082	8	5
	K028	8	5
	K011	7	10
	K009	7	8
Pesticides and Agricultural Chemicals	K042	10	3
	K043	9	6
	F002	9	6
	K034	9	5
	P059	9	4
	U036	9	5
	K036	9	5
	K041	8	6
	K097	8	6
	K031	7	7
	K035	7	6
	K032	7	5
	K040	7	5
	K037	5	4
	K033	5	7
	K038	4	6
	K099	4	7
	K039	1	5
Petroleum Refining	K050	6	6
	K048	5	8
	K049	5	8
	K051	4	8
	K052	4	6

* Ranking: 10 = high, 1 = low

Small Quantity Generators: In 1984, HSWA expanded the universe of regulated generators under EPA by reducing the exclusion from hazardous waste regulations for those firms that generate over 1,000 kg or more per month down to 100 kg or more per month.[13] Studies reveal that the small quantity generators represent by far the largest number of hazardous waste producing establishments in the U.S., but they contribute only a small amount of overall hazardous waste generated annually—less than 0.5 percent.

Despite the amount of waste generated, the SQGs are of particular interest because they may be less capable of dealing with the waste they generate than larger volume generators. They also are likely to have more difficulty in complying with the new regulations and may also be less capable of implementing waste minimization techniques. Such burdens may result in a higher percentage of the SQGs resorting to illegal dumping. The extent of current illegal disposal activities is a matter of speculation, but a report to Congress based on 1983-84 data recognized it as a potential problem.[14] As the cost of managing their hazardous wastes increases, many economically distressed firms may see illegal disposal as the only way to continue operating.

Figure 2-4 indicates that the largest percentage of SQGs are nonmanufacturing concerns, primarily vehicle maintenance (70 percent). Manufacturing establishments account for only about 14 percent of the total SQGs, with most of these falling in the metals category. The distribution of waste generated by volume differs between SQGs and all

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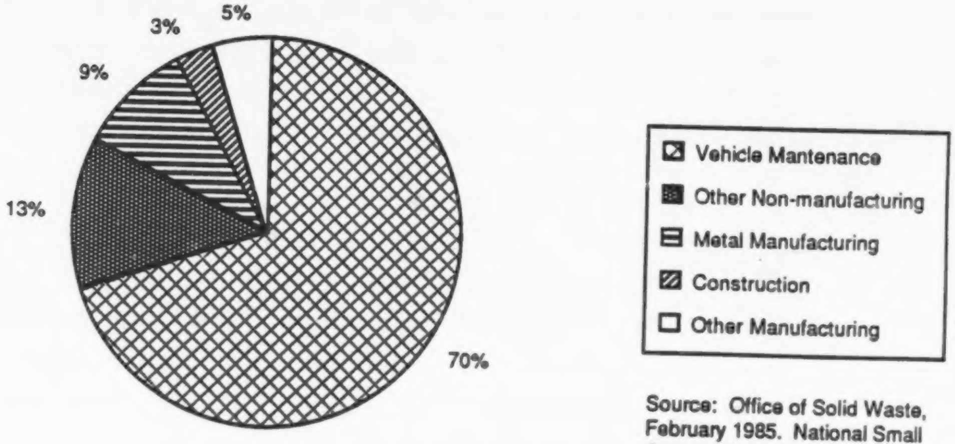
[13] Small Quantity Generators (SQGs) are defined by the EPA in terms of the quantity of waste they generate, not by size of firm. SQGs are those firms, "...who produce less than 1,000 kg of hazardous waste per month." *National Small Quantity Hazardous Waste Generator Survey*, USEPA, Office of Solid Waste, Washington, D.C., February 1985, p.1.

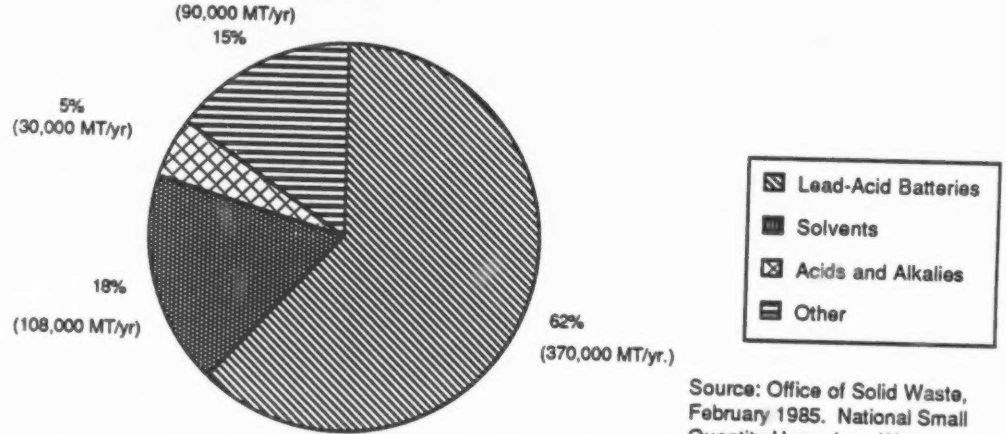
[14] *Illegal Disposal of Hazardous Waste: Difficult to Detect or Deter*, U.S. House of Representatives, Subcommittee on Investigations & Oversight Committee on Public Works and Transportation, GAO/RCED-85-2, February 22, 1985. The report also listed the disposition of 28 of 34 cases where illegal disposal or failure to follow regulations occurred and resulted in conviction. Many were small firms (e.g., auto repair shop, septic tank servicing company, pool cleaning company, machine shop operation) that met the pre-HSWA criterion for generation (less than 1000 kg/month) but were not large producers. This does not assume that small generators of hazardous waste are the predominant class of illegal dumpers or that they dump the largest percentage of waste; they may actually be less capable of camouflaging their dumping activities than larger more resourceful manufacturers, transporters, or disposers.

Figure 2-4
Distribution of Small Quantity Generators by Industry Group



Source: Office of Solid Waste, February 1985. National Small Quantity Hazardous Waste Generator Survey, USEPA.

Figure 2-5
Distribution of Small Quantity Generator Waste by Waste Stream



Source: Office of Solid Waste, February 1985. National Small Quantity Hazardous Waste Generator Survey, USEPA.

other industries.[15] For SQGs, the major portion of waste generated is lead-acid batteries (62 percent), primarily from the nonmanufacturing vehicle maintenance establishments (see Figure 2-5).[16] Solvents, acids, and alkalies provide an additional 23 percent of the wastes generated by SQGs. These wastes are primarily from metal manufacturing, vehicle maintenance, equipment repair, printing, and construction. The balance of SQG waste (15 percent) comes from pesticides, photographic wastes, dry cleaning filters and filtration residues, ignitable wastes, and spent plating wastes.

The SQG survey data do not allow for determination of key constituent concentrations in the waste stream for each industry, but some of the SQG waste streams are similar to those of larger industries. For example, the waste streams from SQG chemical manufacturing include ignitable wastes, spent catalysts, spent solvents, heavy metal dusts, and strong acids and alkaline wastes, waste streams that are similar to those generated by larger firms in the same industrial sectors.

Current Industrial Waste Minimization Practices

The two major categories of waste minimization activities considered in this report are source reduction and recycling. Each of these general activities comprises a wide range of technologies and practices, with the nature and extent of waste minimization varying dramatically from one industrial sector to the next. Current source reduction and recycling practices are discussed separately below.

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[15] The industrial categories are not directly comparable among the SQG report and the industrial categories used by in the CBO study, the RCRA Risk/Cost Analysis Model, and the RIA Survey. The SQG report groups multiple 4-digit SICs together for each industry, whereas the other data are grouped individually by 4-digit SIC code.

[16] Lead acid batteries are a highly recyclable waste and, therefore, less of a problem for the environment. While the SQG report estimated that nearly 90 percent of lead acid batteries were recycled, a more recent study for EPA's Office of Policy Analysis (May 1986) estimates that changes in the lead market have recently reduced the amount of lead recycled. This report stated that by 1985 the battery recycling rate had dropped to about 59 percent from a high of 87 percent in 1980. The report further estimated that given current market conditions and predictions, "...there is no reason to expect that secondary production will increase from current levels, and it may even decline further." See:*The Impacts of Lead Industry Economics on Battery Recycling*, USEPA, Office of Policy Analysis, Washington, D.C., May 16, 1986.

Source Reduction

As discussed in Chapter One, source reduction is any activity that reduces or eliminates the volume or toxicity of a waste exiting from a manufacturing process. The activities most readily identifiable with source reduction are in-plant changes, such as the following:

- Input material modification: use of higher grade, more pure material inputs.
- Technology modifications: changing the method of production or the production equipment itself.
- Procedural/institutional management practices: good operating practices or housekeeping practices.
- Product substitution: replacing original materials with substitutes of equivalent function.

In the past, industry typically considered the implementation of source reduction practices only if such practices resulted in improved product yield (such as through improved chemical conversion) or lower manufacturing costs (such as from more efficient operating procedures, decreased use of raw materials, energy conservation, or lower labor costs). However, since about 1970, environmental regulations under RCRA, the Clean Water Act, and Clean Air Act have also influenced the context in which industry has calculated these costs; in some cases, source reduction has occurred as a direct consequence of regulation, such as under the Clean Water Act requirements regarding waste water treatment.

Preliminary estimates suggest that industry might be generating more than twice the amount of waste per unit of production than it does at present if no source reduction techniques were in place today.[17] This estimate is derived from an extrapolation of the effectiveness and extent of source reduction practices used in 22 individual industrial and manufacturing processes to a national basis. Moreover, this estimate of the effectiveness and rate of current application of the various source reduction techniques could only be based on EPA's engineering analysis of qualitative information gathered from literature reviews, case studies, trade associations, and other sources. The results, therefore, must necessarily be viewed as exploratory rather than definitive representations of the waste minimization issue.

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[17] *Waste Minimization Issues and Options*, Volume I, USEPA, Office of Solid Waste, Washington, D.C., October 1986. .

Table 2-3 illustrates the relative extent of current and potential source reduction, by volume. These estimates, based on the qualitative information described above,[18] reflect current practices and trends in the industries named. They do not consider current technological innovations, implementation of HSWA's new programs, or other incentives now faced by generators. It should be noted that much of the estimated current reduction did not occur as a result of actions designed specifically to reduce waste, but were largely incidental to efforts to maximize yields, improve operating efficiency, and comply with other Federal environmental regulations (e.g., the Clean Air Act, the Clean Water Act). It should be emphasized that, despite any current waste minimization, over 200 million metric tons of hazardous waste continue to be generated annually.

With the limited information available, it appears that American industry has made progress towards minimizing waste. Based on its studies of industrial waste minimization practices, however, EPA believes that significant additional reductions can still be made. While there may be technical limits to the degree of source reduction that can be achieved in an individual production process, EPA believes that in most cases such limits have not yet been reached. If generators are to achieve their source reduction potential, significant additional efforts will be needed.

Available information suggests that the chemical and allied products industry, which is the largest generator of hazardous waste, still has the greatest potential for volume reduction. This appears to be true despite the fact that this industry has already reduced its waste volume to a greater degree than other industrial sectors. Preliminary evidence suggests that, within the next 25 years, aggregate waste generation volumes can be reduced an additional 15 to 30 percent by the extension of existing source control techniques and the

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[18] *Ibid.*

Table 2-3
Estimated Extent of Current and Future Source Reduction

Industry Sector	Percent of Current Waste Generated Nationally	Extent of Estimated Source Reduction since Mid-70's	Potential for Future Source Reduction	Volume of Waste Remaining after Future Reductions
Chemicals & Allied Products	47.9	High	Medium	Very High
Primary Metals	18.0	High	Medium	Medium-High
Petroleum & Coal Products	11.8	Medium	Medium	Medium
Fabricated Metals	9.6	Low-Medium	Medium-High	Medium
Rubber & Plastics	5.5	High	Medium	Low-Medium
Machinery (except Elec.)	2.1	Medium	Medium	Low-Medium
Miscellaneous Manuf.	1.8	Medium	Medium	Low-Medium
Transportation Equip.	1.1	Medium	Medium	Very Low
Motor Freight Transportation	0.8	Low-Medium	Medium-High	Very Low
Electric & Electronic Equip.	0.7	Low	Low-Medium	Very Low
Wood Preserving	0.7	High	Low-High	Very Low
Drum Reconditioning	<0.1	High	Low-High	Very Low

Source: Office of Solid Waste, October 1, 1986. "Waste Minimization Issues and Options," Volume I, USEPA, Washington, D.C.. Interpolation of data in text. Data is based upon Congressional Budget Office, and RIA Mail Survey.

development and application of new technologies.[19] It should be noted, however, that some firms or small industries may not be able to achieve such levels of reduction.

Input material modification: The effectiveness of input material modification as a source reduction technique generally differs according to the type of processing involved. Raw materials that are directly synthesized (converted) into a product can be purified prior to processing to reduce waste generation but, since most primary feed materials used in synthesis are already relatively pure, this technique generally results in minimal source reduction. For example, the use of a more costly, purer, propylene feed in the synthesis of acrylonitrile does not result in an appreciable decrease in the volume of waste that is generated.

Where a process is essentially a purification step, the use of a higher grade (more pure) material or ore yields less waste. The use of a higher grade crude in petroleum refining, for example, reduces the amount of impurities requiring removal during processing. Auxiliary raw materials, which are used in a process but are not converted into product, can sometimes be replaced with less toxic, more environmentally safe, materials. Examples include the substitution of innocuous biodegradable detergents for toxic chlorinated solvents and the use of less toxic compounds in lieu of chromate corrosion inhibitors in cooling towers. Sometimes, however, a manufacturer may substitute a material into the process not because the waste would be less toxic but because the waste is simply not regulated by EPA (i.e., would not be defined as hazardous under Subtitle C of RCRA).

Technology modifications: In certain instances, technology modifications or substitutes are also effective in minimizing wastes. A product can sometimes be manufactured by two or more distinct processes. Certain processes, such as the chloride process for producing titanium dioxide, generate considerably less waste than alternative processes, such as the sulfate process. Unfortunately, modification of existing facilities can involve considerable research and development and capital investments, and can require a lengthy implementation period.

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[19] *Ibid.*, pp. 3-22.

Inefficient chemical reactions in a process are a major source of increased waste generation. Improving the efficiency of the process through modification of catalysts, reactor design, and operating parameters has been shown to reduce the quantity of waste generated significantly. For example, in the production of acrylonitrile by the catalytic ammoxidation of propylene, switching from an antimony-uranium catalyst to a ferrobismuth phosphomolybdate catalyst has boosted the conversion of acrylonitrile by 35 percent. In another instance, there has been a significant decrease in tar formation where changes in reactor design improved mixing for the manufacture of epichlorohydrin. Attaining zero waste generation, however, is currently beyond the technical capabilities of most chemical processors.

Modification of equipment is another way to reduce waste generation. The invention of mechanical wipers to scrape the sides of paint tanks, for example, reduces the exposed volume of waste paint that would otherwise produce fugitive volatile organic compound (VOC) emissions. Similarly, process automation, which helps optimize product yields by automatically adjusting process parameters, has in many cases minimized operator error, reduced the likelihood of spills, and discouraged the production of off-specification materials. As noted earlier, these off-specification materials can be highly toxic, albeit lower volume, wastes.

Water conservation can also result in significant waste reduction. Efficient product washing results in reduced sludge generation by minimizing the amount of product lost to the wash water and the quantity of wastewater that is generated.

Technology modification is currently a central focus of waste minimization. Generally these changes are most cost-effective when implemented during a plant's planning or design period or when a plant is retooling and replacing worn out equipment. Retrofitting plants that have already been designed and/or constructed is often expensive and difficult. Consequently, while technology modification may be of limited effectiveness in reducing waste generation and toxicity from existing sources, it can be effective in future expansion and construction.

Procedural/Institutional management practices: "Good operating practices" or "good housekeeping practices" involve the alteration of existing procedural, organizational, or institutional aspects of a manufacturing process. The goal is to limit unnecessary generation of waste attributable to human intervention (or the lack of it). Employee training, management initiatives, inventory control, waste stream segregation, improvements in materials handling, scheduling improvements, spill and leak prevention, and preventive maintenance are all examples of good operating practices. Others include the scheduling of batch operations to limit the frequency of equipment cleaning and, consequently, waste generation; the segregation of hazardous wastes from nonhazardous wastes to minimize the volume of contaminated wastes; and the reduction of overspray and runoff from spraying by the paint booth operator during paint application (refer to Appendix A's section on Segregation of Wastes for additional examples).

Product substitution: Replacement of an original product with a different product that is intended for the identical use can be an effective method of source reduction. For example, integrated pest management, an alternative to pesticide use in certain applications, reduces pesticide production and, in turn, the waste generated during pesticide production and application. The substitution of concrete pilings for creosote-treated timbers eliminates wastes from the manufacture of the creosote-treated pilings. Substitution of less toxic solvents, such as petroleum solvents for more toxic solvents such as perchloroethylene or trichloroethylene, generates a spent solvent waste that is less toxic.

It is difficult to quantify the current status or effectiveness of this source reduction technique. Each substitution needs to be evaluated on a case or application-specific basis. The viability of a substitute can be based on:

- Whether the substitute can function adequately as a replacement;
- Whether the economic cost of a substitute justifies its use as a replacement,
- Whether the manufacture and disposal of a substitute reduces environmental consequence;
- Whether the cost/environmental benefit of the substitute is sufficiently attractive; and

- Socio-political factors, such as government action (e.g., procurement policy) to promote the substitute.

Tradeoffs have to be weighed prior to the selection of substitutes. For example, water-based inks, sometimes used in gravure and flexographic printing, have the advantage of being less toxic than solvent-based inks, but require more energy to dry, possess a low gloss, can cause paper to curl, and occasionally require brief process stoppages. Petroleum solvents can be used in drycleaning, but they are much more flammable than the more commonly used but more toxic perchloroethylene.

Available data are insufficient to quantify the current effectiveness of source reduction practices in reducing volume or toxicity. In qualitative terms, data indicate that industry has already considerably reduced the volume of its wastes. Most of these source control methods, however, have been employed (1) to reduce costs or improve product quality, and, in turn, increase profits and (2) to respond to existing environmental regulations. Rarely have these practices been used solely for the purpose of waste minimization. Based on EPA's analysis, information suggests that further significant source reduction does appear feasible and practicable.

Recycling

Viewed generically, "recycling" encompasses both reuse and reclamation activities. The discussion in this section on recycling activities regulated under HSWA pertains to hazardous waste recycling for materials recovery as well as for energy recovery. A recycler's decision as to how to treat a waste is principally determined by the character of specific waste streams or waste mixtures. Where treatment should take place (either onsite or offsite), however, is a function of a generator's management practices which include:

- Sensitivity to insurance liability,
- Proximity to offsite recycling facilities,
- Economic costs related to the transportation of wastes,
- The volume of wastes available for processing, and
- Costs related to storage of waste onsite compared to offsite.

Recycling is characterized by three major practices: (1) direct use or reuse of a waste in a process, (2) recovery of a secondary material for a separate end use such as the recovery of a metal from a sludge, and (3) removal of impurities from a waste to obtain a relatively pure reusable substance. (Practices (2) and (3) are defined as reclamation by EPA.)

Materials recovery: Although recycling of selected streams is practiced to a considerable degree by certain industries, only about 4 percent of the hazardous waste generated in the United States was recycled in 1981, according to the 1981 RIA Mail Survey. Of the waste that was recycled, 81 percent by volume was recycled onsite. Offsite recycling, however, is becoming increasingly common with the advent of commercial recyclers and direct transfer of wastes from generators to others who can reuse the wastes. Table 2-4 summarizes these data for the ten highest volume waste generating industries.

Recycled wastes are used as feedstocks in production processes or as substitutes for commercial chemical products. Examples include:

- The reuse of solvents for equipment cleaning;
- The recycling of collected pesticide dusts at pesticide formulators; and
- The reuse of ferric chloride wastes from titanium dioxide manufacturing as a wastewater conditioner in water treatment.

The proportion of waste that is recycled is both industry and waste-specific. In general, certain wastes, such as solvents, tend to be recycled more often than others, such as pesticides. Factors that influence whether an industry recycles its waste include (1) the type of waste generation process used; (2) the volume, composition, and uniformity of wastes; (3) whether uses and reuses of the wastes have been identified, and (4) availability and price of virgin materials relative to the costs of recycling and storing the wastes. Toxicity of the waste does not appear to be a direct factor in the recyclability of a generated waste, although, as noted previously, high volume wastes, which are often less toxic, are more commonly recycled. Based on limited data, some industry-specific observations can be made:

Table 2-4
Ten Highest Volume Waste Generating Industries†

Generation and Recycling Volumes during 1981

SIC	Industry	Volume of Waste Generated	Total Volume Recycled		Volume Recycled Onsite		Volume Recycled Offsite	
		M gals*	M gals*	Percent**	M gals*	Percent**	M gals*	Percent**
28	Chemicals and Allied Products	28,000	340	1.2	300	1.1	32	0.1
35	Machinery, Except Electrical	4,200	26	0.6	18	0.4	7.9	0.2
37	Transportation Equipment	2,300	900	39.0	880	38.0	22	0.9
42	Motor Freight Transportation	1,700	NR		NR		NR	
29	Petroleum and Coal Products	1,300	36	2.8	32	2.5	4.2	0.3
33	Primary Metal Industries	1,000	170	17.0	18	1.8	150	15.0
17	Construction: Special Trade Contractors	870	0.2	<0.1	0.1	<0.1	0.1	<0.1
34	Fabricated Metal Products	820	24	2.9	14	1.7	9.6	1.2
36	Electric and Electronic Equipment	670	47	7.0	0.4	<0.1	46	6.9
49	Electric, Gas, and Sanitary Services (includes POTWs)	470	3.3	0.7	0.1	<0.1	3.2	0.7
	Total:	40,860	1543.2		1262.5		271.8	

† These are wastes recycled at the end of the production process.
* Reporting error accounts for onsite and offsite volumes not equaling total volume recycled.
** Percent of total waste generated (by SIC).
NR: No Recycling of this type reported in RIA Generator Survey.

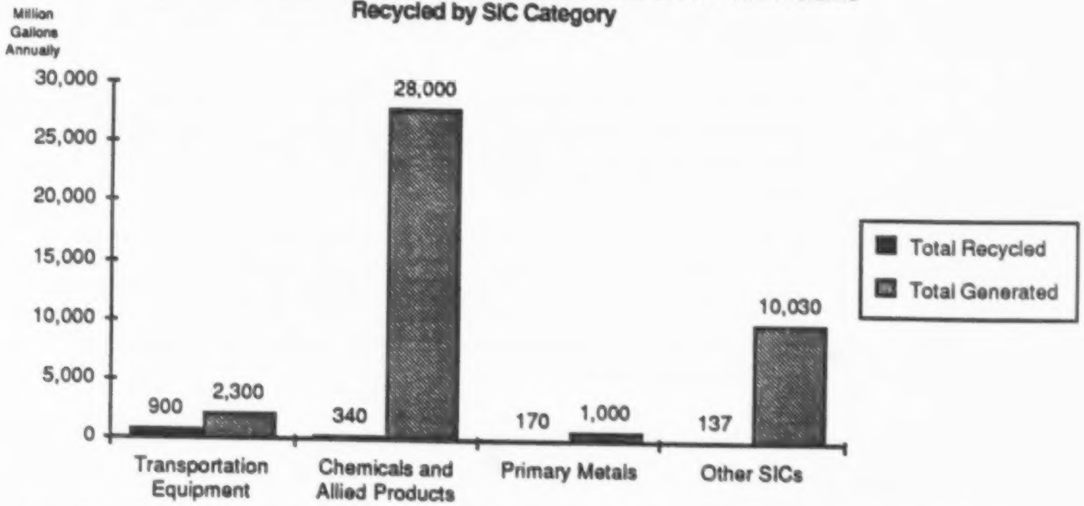
Source: Office of Solid Waste, 1984, National Survey of Hazardous Waste Generators and Treatment, Storage, and Disposal Facilities Regulated Under RCRA in 1981, USEPA.

- As shown in Figure 2-6, three manufacturing industries, transportation equipment, chemical and allied products, and primary metals, account for 91 percent of the total hazardous waste recycled in 1981.
- In Figure 2-7, it is apparent that while these three sectors may account for the largest portion of the total volume of waste recycled, the amount they recycle compared to the total waste generated by all sectors is actually very small.
- Eighty-one percent of those recycled wastes were recycled onsite. Data indicate that large generators tend to recycle onsite, while smaller generators who recycle ship their wastes offsite, often to commercial recyclers, because they lack (1) onsite space or (2) a waste volume of sufficient quantity to justify the expense of recycling equipment.

On review of the available data, most notably the 1981 RIA Mail Survey, one can draw certain conclusions about the types of waste streams that are most often recycled. Generally, the streams that are recycled in the greatest volumes are dilute waste streams containing a constituent that can be reused in large-scale applications by a generator. This was true in 1981 for the chemical and allied products sector, which recycled spent acids and alkaline solutions (classified as D002 wastes under RCRA); the transportation equipment industry, which recycled its wastewater treatment sludges from electroplating (F006) and chromium plating (D007) processes; and the primary metals industry, which recycled spent pickle liquor (K062). These streams are of varying toxicity, and data are inconclusive as to whether toxicity plays a role in a stream's being recycled.

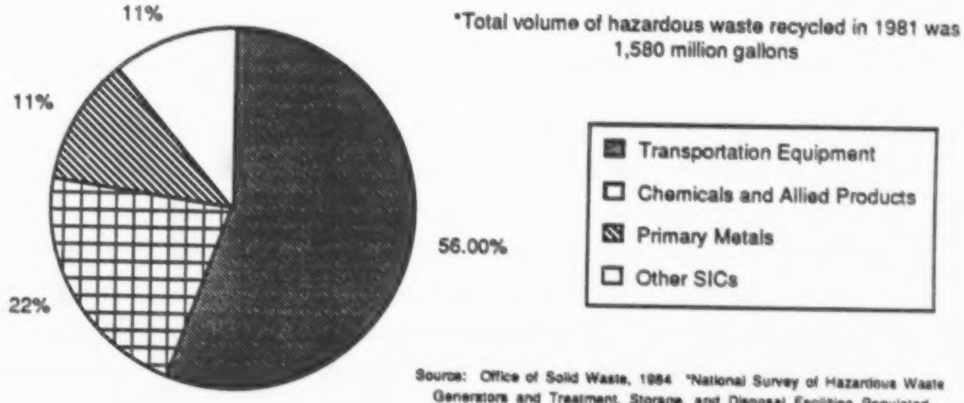
Solvents tend to be recovered in larger proportion than other wastes. This is because there is both an existing technology to allow recovery and because a market exists for the recycled solvent. The available technology (e.g., distillation) is relatively inexpensive to operate and can attain high purity levels (95 percent or higher). In other cases, however, production processes generate wastes that are not practical for recovery since the recovered wastes themselves would not be useful in production. RCRA K-code wastes fall into this category. In these cases, source reduction technologies may be more appropriate to achieve waste minimization.

Figure 2-6
Comparison of Total Volume Hazardous Waste Generated to Total Volume Recycled by SIC Category



Source: Office of Solid Waste, 1984, National Survey of Hazardous Waste Generators and Treatment, Storage, and Disposal Facilities Regulated Under RCRA in 1981, USEPA.

Figure 2-7
Distribution of Total Volume* of Hazardous Waste Recycled during 1981, by SIC Category



*Total volume of hazardous waste recycled in 1981 was 1,580 million gallons

Source: Office of Solid Waste, 1984 "National Survey of Hazardous Waste Generators and Treatment, Storage, and Disposal Facilities Regulated Under RCRA in 1981," USEPA

Energy recovery: Based on the 1981 RIA Mail survey, data on recycling indicate that recycling for materials recovery and reuse appears to be more popular than fuel use or energy recovery. There are two reasons why this is so. First, some wastes that could be recycled for energy recovery can also be reclaimed and reused over and over. Energy recovery, in contrast, destroys the inputs. Only when the waste is too "dirty" (contaminated from repeated reuse) do generators consider energy recovery a desirable option. The 1981 data may not, however, provide a completely accurate picture of current practices because of recent developments in energy recovery technology. Many technologies were not available in 1981, and others are only beginning to be commercially available today. Solvents tend to be used for energy recovery because they can possess high energy values. Data from the RIA Mail Survey (see Figure 2-8 on recycling practices for five waste streams) indicate that solvent wastes are either the most often or nearly the most often waste recycled as a fuel supplement.[20]

Data from the survey on hazardous waste generators indicates that among the sample of generators handling their wastes most frequently onsite, energy recovery was reported 78 times as a waste management objective. The types of wastes that generators use for onsite energy recovery are those that fall under the RCRA Code for characteristic ignitable wastes as well as spent non-halogenated solvents, spent halogenated solvents, and slop oil emulsion solids from the petroleum refining industry. Waste managers would also

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[20] *National Profiles Report for Recycling: A Preliminary Assessment*, Draft Report, USEPA, Office of Solid Waste, Washington, D.C. ,July 8, 1985, pp. 3-1 to 3-4. The five generic waste streams are defined as follows:

Solvents: Halogenated and/or nonhalogenated solvent wastes.

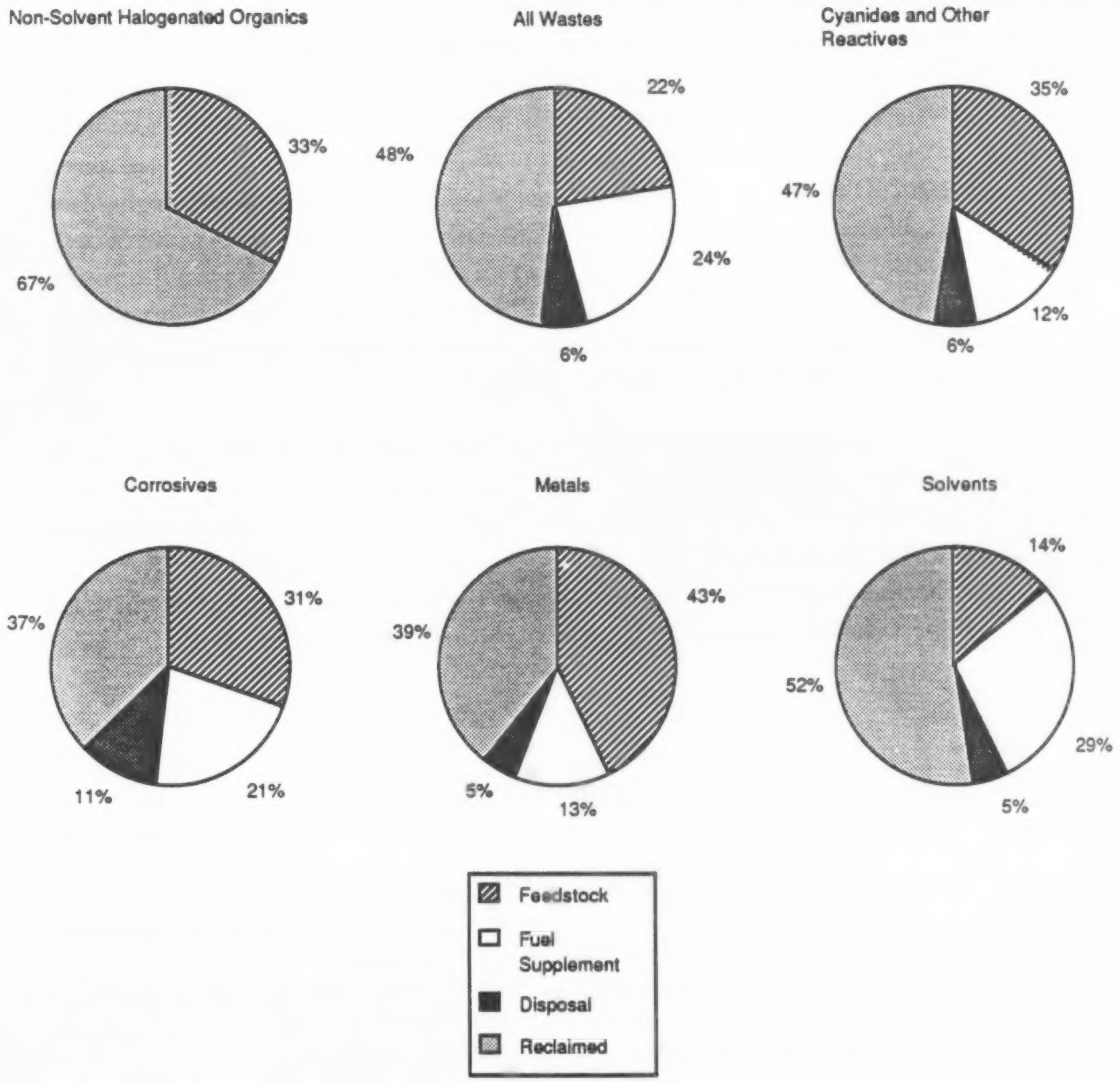
Halogenated Organics other than Solvents: Halogenated organic compounds other than solvent wastes; pesticides are the major component of this waste category.

Metals: Wastes containing significant levels of metals, and organic and inorganic metal compounds.

Corrosives: All acidic and basic corrosive wastes such as acids and bases.

Cyanides and Other Reactives: Wastes with cyanide constituents, including complexes and organic and inorganic cyanides; sulfides; explosives; water reactives; and strong oxidizers and reductants.

Figure 2-8
Major Recycling Practices for
Selected Waste Streams from
the RIA TSDF Survey



Source: Waste Treatment Branch, July 8, 1985, National Profiles Report for Recycling: A Preliminary Assessment, Draft, USEPA, Washington, D.C.

use other onsite recycling technologies for managing of these wastes, including use as a feedstock, disposal,[21] and reclamation.

Currently, only the burning of hazardous wastes in incinerators is subject to regulation under RCRA, though burning hazardous waste in boilers and industrial furnaces can also pose a hazard to human health and the environment. EPA's definition of recycling, does specifically address burning, and indicates that burning of hazardous wastes for energy recovery is a hazardous waste recycling activity.[22]

Other recycling technologies: Wastes that have a higher constituent concentration are usually selected for recovery and reclamation. Data suggest that there are threshold levels for those wastes that must be reached before they can be considered eligible for the recycling process. Halogenated solvent and nonsolvent wastes must be, on average, in the range of 35 to 40 percent before recovery or reuse technologies are practical.[23] For other wastes, such as nonhalogenated solvents and corrosives, the threshold levels are lower for recovery or reuse practices. In any case, the average concentration level for the material being recovered using reclamation technologies is higher than that for any of the other management practices (such as onsite wastewater treatment, surface impoundments, wastewater discharge, land disposal, and treatment of organics).[24]

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[21] Disposal refers to recycling by placement on the land. For example, a waste used as a fertilizer or soil stabilizer.

[22] For EPA regulations that do concern burning see: 40 CFR 260.10 which defines a "boiler", "incinerator," and "industrial furnace"; also 40 CFR 261.6 and 40 CFR 266 (Subpart D) which address the burning of hazardous wastes for energy recovery in boilers and in industrial furnaces. To fit the definition of "boiler," devices must maintain a minimum amount of thermal energy recovery (60 percent). Of the 60 percent, 75 percent must be applied usefully and beneficially. The definition of "industrial furnace" also requires the recovery of materials or energy. If a controlled thermal combustion device meets neither of these criteria, it is defined as an "incinerator" by EPA and requires a permit under Subpart O of the RCRA regulations. In this report, references to such burning activities may in some instances include situations in which less than 60 percent energy recovery is achieved. We have assumed, however, that future instances of burning for energy recovery will meet the requirement stated in the EPA regulations.

Currently, hazardous waste storage at existing boilers and industrial furnaces are subject only to interim status standards under Part 265. Regulation of the actual burning practices of boilers and industrial furnaces has been deferred pending Agency activities to determine whether regulations for burning in these devices should differ from those for incinerators in light of the scope, practices, and different combustion devices and wastes involved.

[23] *Waste Minimization Issues and Options*, Volume I, USEPA, Office of Solid Waste, Washington, D.C., October 1986.

A number of other typical characteristics are common to waste streams that are recycled. To be economically and technically viable for recycling, a stream usually must be uniform, i.e., it must not contain more than one contaminant. Other factors that must be met in order for recycling to be successful include:

- A market for the recycled material must exist within an economically viable distance; and
- The recycled waste must meet purity requirements for manufacturing processes.

Because recyclable wastes must be economically competitive with virgin material they are replacing, the wastes often must be processed prior to reuse. Reclamation processes include chemical, physical, and electrochemical separation. Some of the major technologies include the following:

- Distillation of solvent wastes;
- Dechlorination of halogenated, nonsolvent wastes; and
- Metal concentrating techniques such as leaching, solvent extraction, ion exchange, precipitation, crystallization, and evaporation to treat dilute metal-bearing waste streams.

While not as common as onsite recycling, commercial offsite recycling is becoming increasingly popular. It is, in fact, favored by some industries, most notably primary metals and small quantity generators of lead-acid battery wastes. Offsite recycling usually occurs at mobile plants, centralized recovery facilities, or other commercial recycling plants. An increasingly popular commercial recycling service called batch tolling accepts hazardous wastes from a generator only for treatment and return of the recovered product to the same generator for reuse. The recycler charges a fee to the generator for recovery of the reclaimed material. Some small volume generators have actually pooled their resources and now operate centralized recycling facilities, thereby reducing their capital and operating costs.[25]

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[24] *Ibid.*, pp. 4-16 to 4-22.

Certain wastes that are not useful to a generator may be desired by another industry as a raw material. Waste exchanges are often helpful in facilitating the transfer and recycling of these wastes. They serve as information clearinghouses (listing wastes that are available or desired), and can also act as brokers; occasionally they actually transport wastes from one plant to another. Available information suggests that approximately 20 to 30 percent of all wastes listed by exchanges are eventually recycled. Some of the wastes that are most often recycled include acids, alkalis, solvents, metal wastes, and corrosives.

Activities of the States in Support of Waste Minimization

Section 1003(a)(7) of RCRA directs the EPA to establish a "viable Federal-State partnership to carry out the purposes of this Act" and "give a high priority to assisting and cooperating with the States in obtaining full authorization of State programs under Subtitle C." This directive reflects the intent of the Congress that the States bear final implementation responsibility for their hazardous waste programs. This approach recognizes that the State hazardous waste programs are located closest to the communities that are most significantly affected by hazardous waste problems. The States are, therefore, the most appropriate level of government to take the initiative to develop and implement their own hazardous waste management program.

Under RCRA, EPA implements the hazardous waste activities until States are given authority to do so. EPA's management of the national hazardous waste system attempts to strike a balance between the need for a uniform national system and the wide-ranging diversity of States' hazardous waste priorities. Differing priorities affect differences in the magnitude of States' hazardous waste problems, economic priorities, and financial and institutional commitment to regulating hazardous waste. The limited extent of some States' development of waste minimization programs may also reflect State decisions to spend more time implementing HSWA and the base RCRA program. The evidence suggests, however, that many State officials support the hazardous waste programs since there is sufficient political support for their efforts.

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[25] *Ibid.*

State officials' perceptions of State commitment: Many State hazardous waste program officials believe that they currently enjoy sufficient political support for their regulatory activities. Interviews of State hazardous waste program officials conducted in 1985 during the initial implementation of HSWA revealed that among 26 environmental officials from 22 States, two-thirds believed that they enjoyed sufficient political support.[26]

In addition to being informative, these interviews provided indications of how State program officials tend to assess the commitment of the State to support hazardous waste regulation. Officials assessed commitment to regulation in the following ways:

- Adequacy of financial and administrative resources to carry out the hazardous waste program activities;
- Adequacy of executive branch support most often displayed in terms of the degree of priority in the Governor's operating budget;
- Adequacy of statutory authority granted to the regulatory agency by the State legislature; and
- Adequacy of public support for the activities of the State program.

For example, officials representing 17 State programs indicated that their legislatures had provided adequate statutory authority to run a viable hazardous waste program. Moreover, 14 State officials asserted that their programs had adequate executive branch support to implement their program activities, although they recognized that availability of financial resources would be a continuing source of concern, which generally extends to States' needs for funding to support waste minimization.

Substantive State progress toward waste minimization: There are several types of activities by which States encourage waste minimization. The mix of waste minimization activities adopted by States varies as does the size of waste minimization programs. Individual strategies include:

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[26] *Perceptions of Progress: Initial Reactions to HSWA, Hazardous Waste Management Project*, USEPA, Office of Solid Waste, Washington, D.C., June 1, 1985.

- Regulatory exemptions if waste materials are recycled;
- Land disposal restrictions for certain waste materials and management practices;
- Fee and tax incentive programs, as well as financial assistance in the form of loan, bond, and grant assistance programs; and
- Information programs such as information transfer, technical assistance, and waste exchanges.[27]

Table 2-5 indicates the types of activities that individual States have undertaken to expedite waste minimization. In sum, seven States have instituted recycling exemptions or variances and land disposal restrictions. Twenty States have instituted at least one type of fee or tax incentive program. Nineteen States have initiated at least one of the three types of information programs.

Hazardous waste regulatory programs in most States are modeled after the Federal RCRA program. Waste minimization practices are encouraged by State regulations through exemptions from, or relaxation of, otherwise applicable regulatory requirements. A recycling unit does not require a TSD permit under the Federal regulations. Shipping of hazardous wastes offsite for recycling requires a manifest, and storing wastes for longer than 90 days, even if wastes are to be recycled, requires a permit. For most States, exemptions from recycling practices are the same as Federal requirements. For example, Wisconsin's regulations provide "exemptions" from licensing of a treatment facility for legitimate reclamation or recovery of hazardous wastes, beneficial use or reuse, energy recovery, or other innovative recycling activities.[28] Beyond existing Federal requirements, in California, generators of wastes deemed recyclable must recycle those wastes or must by request of the State regulatory agency provide written justification for not recycling them. Such justification must provide a summary of efforts made to find a use for the waste and technological and economic reasons for not recycling the waste.[29]

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[27] *Waste Minimization Issues and Options*, Vols. 1 - 3, USEPA, Office of Solid Waste, Washington, D.C., October 1986; see also Appendix A of this Report, "Technical and Financial Assistance Programs."

[28] *Ibid.*, pp. 7-23.

[29] Article 12, Sections 66763 and 66796, California Hazardous Waste Control Act.

Notes:

a. Assessed on Generators or Disposers by the State on a Waste Basis and Does Not Include Permit Application Fees.

b. Received for Implementing Source Reduction or Recycling.

c. Sources Identified No Fee and Tax Incentives that Promote Waste Minimization.
Sources: CBO 1985, EPA 1984, GAO 1984, Wisconsin DNR 1983, Bulanowski et. al. 1981, Various State Statutes and Regulations and Personal Communications with State Personnel.

d. Exemption is in Form of Fee Waiver if the Waste is Rendered Nonhazardous Onsite.

e. Sources Identified No Information Programs That Directly Address Waste Minimization within These States.

	EXEMPTIONS & RESTRICTIONS		FEE AND TAX INCENTIVES					INFORMATION PROGRAMS		
	RECYCLING EXEMPTIONS/VARIANCES	LAND DISPOSAL RESTRICTIONS	FLAT FEE AND/OR WASTE END TAX[a]	GRADUATED FEE AND/OR WASTE END FEE[a]	EXEMPTION/EXCLUSIONS FOR WASTE FEES/TAXES[b]	FEEDSTOCK OR OTHER TAX	CREDITS/EXEMPTIONS/REDUCTIONS ON SALES, INCOME, OR PROPERTY TAXES[b]	INFORMATION TRANSFER	TECHNICAL ASSISTANCE	WASTE EXCHANGE
ALABAMA			●					●		
ALASKA[c,e]										
ARIZONA[c]										●
ARKANSAS[e]										
CALIFORNIA[d]	●	●		●	●			●	●	●
COLORADO[e]			●							
CONNECTICUT[e]	●		●							
DELAWARE[c,e]	●									
DISTRICT OF COLUMBIA[c,e]										
FLORIDA			●		●	●				●
GEORGIA[c]								●	●	
HAWAII[c,e]										
IDAHO[e]										
ILLINOIS		●		●				●	●	●
INDIANA[e]	●		●		●					
IOWA[e]				●	●					
KANSAS	●	●	●					●		
KENTUCKY	●	●		●	●			●		
LOUISIANA		●		●				●		
MAINE[e]	●			●		●				
MARYLAND[c]	●	●						●		
MASSACHUSETTS[e]	●	●						●		
MICHIGAN							●			●
MINNESOTA	●	●		●	●			●	●	
MISSISSIPPI[e]			●							
MISSOURI	●		●		●					●
MONTANA[c]										●
NEBRASKA[c,e]										
NEVADA[c,e]										
NEW HAMPSHIRE[e]			●		●	●				
NEW JERSEY[c]	●	●				●		●		●
NEW MEXICO[c,e]										
NEW YORK		●		●	●			●	●	●
NORTH CAROLINA		●	●				●	●	●	●
NORTH DAKOTA[c]										
OHIO				●				●		
OKLAHOMA[c,e]										
OREGON[e]				●			●			
PENNSYLVANIA[c]	●							●	●	
RHODE ISLAND[c,e]										
SOUTH CAROLINA[e]			●							
SOUTH DAKOTA[c,e]										
TENNESSEE	●			●	●			●		
TEXAS			●							●
UTAH[c]										●
VERMONT[e]				●						
VIRGINIA[c,e]										
WASHINGTON		●		●				●		
WEST VIRGINIA[e]				●	●					
WISCONSIN	●	●		●			●	●		
WYOMING[c]	●	●		●			●	●		

TABLE 2-5 SUMMARY OF STATES' WASTE MINIMIZATION ACTIVITIES

Waste minimization practices are also encouraged through State disposal restrictions, some of which may be more stringent than those of EPA. Such restrictions may include (1) bans on certain waste materials and types of management; (2) facility standards (such as liner requirements and ground-water monitoring); and (3) requirements for receipt of specific approval from a regulatory agency prior to disposal of a particular waste stream. Kansas, Illinois, and New York are examples of States that prohibited the land disposal of various solvents, dioxins, and other hazardous organics before the Federal regulations called for restrictions of the substances in 1984.[30] California established the first State land disposal restriction program in late 1981. The program banned specific wastes from land disposal. The schedule of bans is contingent upon a determination by the California Department of Health Services (DHS) that sufficient recycling and treatment capacity for the specified wastes will be permitted and fully operational by the day the land disposal restrictions take effect.[31]

State financial incentives to encourage preferred waste management alternatives include (1) permit fees assessed on operators of TSD facilities; (2) taxes assessed on the waste volume of generators or disposers (e.g., waste end taxes); and (3) taxes on the raw materials used by generators of hazardous waste (feedstock taxes). Waste fees and taxes serve not only to generate revenue for various purposes, but are intended to provide incentives for waste minimization. Currently, no States directly tax the manufacture of hazardous substance feedstocks, although four States—Maine, Florida, New Hampshire, and New Jersey—impose a tax on the transfer of petroleum and chemical feedstocks.[32] In 1984, 20 States imposed waste end taxes on hazardous waste generators.

State-provided credit assistance, whether through direct State loans, guaranteed loans, subsidized interest payments for private loans, or bond financing, is a means of reducing the cost to firms of obtaining capital to make an investment toward the purchase of waste reduction equipment or to build and operate waste recycling facilities. Although no States have actually established a loan guarantee program, California currently subsidizes interest rates for the purchase of waste reducing equipment. California, Illinois, Minnesota, and New York provide credit assistance in the form of direct loans for pollution control equipment, which generally include recycling or source reduction investments. Revenue bond financing is used by several State programs to assist firms with the purchase and installation of pollution control equipment. For example, the Missouri Environmental Improvement and Energy Resources Authority (EIERA) has operated a successful bond program for over a decade to provide over $1.5 billion in financing for energy development and pollution prevention projects.[33]

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[30] *Waste Minimization Issues and Options*, Vol. 1 , USEPA, Office of Solid Waste, Washington, D.C. , October 1986, p. 7-25.

[31] The scheduled dates were (1) June 1, 1983, banning of wastes containing free cyanides; (2) January 1, 1984, banning of toxic metal wastes and polychlorinated biphenyls (PCBs); (3) January 1, 1985, banning of liquid wastes containing halogenated organic compounds; and (4) July 1987, banning of organic sludges, solids containing halogenated organic compounds, and lab packs containing any of the restricted wastes.

[32] Office of Solid Waste, *op. cit.*, p. 7-36.

Waste minimization grants are monies awarded to hazardous waste generators, processing facilities, and other public and private organizations to support waste minimization efforts, including research and development activities and demonstrations of recycling and source reduction technology. State grants are a direct method for investigating new and existing technologies. For example, North Carolina's challenge grants program provides matching funds of up to $5,000 to stimulate a generator's investigation of source reduction and recycling on a plant-specific basis; this program is aimed especially at small to medium-sized generators. California, Georgia, Illinois, Minnesota, and Wisconsin also offer grants for projects involving research, development, and demonstrations of source reduction and recycling technology.[34]

Technical and informational assistance at its most basic level consists of development of a library collection of technical information which generators can review to discover technologies that should be useful for minimizing their wastes or locating waste exchanges.[35]. North Carolina's technical information collection, maintained as part of the "Pollution Prevention Pays" (PPP) program, offers an information clearinghouse with

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[33] *Ibid.*

[34] *Ibid.*

[35] Waste exchanges, a type of information program, provide a means for matching the need for waste with the availability of that waste: i.e., companies can use the service to advertise available wastes or to find waste materials they can use.

1,200 references on waste minimization methods, organized by SIC code. Numerous publications are also available through the PPP, such as the *Handbook of Environmental Auditing* and a directory of recycling firms located within the State. To facilitate the exchange of wastes among generators, the California Waste Exchange, like other waste exchanges throughout the country, issues a quarterly newsletter that contains listings on available or desirable wastes. The program also issues a Directory of Industry Recyclers, which lists names and locations of recycling companies and the types of materials they recycle. New York's Industrial Materials Recycling Program, operated through the State's Environmental Facilities Corporation (EFC), publishes informational newsletters, technical papers, and a directory of permitted hazardous waste transporters.

Some State technical assistance programs include direct efforts to help individual generators as well as general efforts to educate important industry groups. Most of the direct assistance to individual generators is provided by telephone, followed by distribution of appropriate written information. The technical assistance staffs in several State programs also provide onsite audits and reviews of particular plant sites. Minnesota's technical assistance program provides plants with engineering students who work directly in the plant during the summer to assist in assessing the needs and opportunities for waste minimization and in planning for them.

Review of Existing EPA Activities Relating to Waste Minimization

Consistent with HSWA objectives to foster waste minimization practices by encouraging process substitution, materials recovery, and properly conducted recycling and reuse wherever possible, and to implement RCRA through the States, the Office of Solid Waste (OSW) has, over the past two years, attempted to design an efficient intergovernmental division of labor among EPA Headquarters, the EPA Regional Offices, and the State hazardous waste programs. EPA Headquarters and the Regional Offices are taking a leading role in support of the Federal-State partnership by conducting three essential functions: regulatory control; technical and financial assistance; and information sharing and management. Each of these is discussed below.

Regulatory Control

EPA has implemented the following waste minimization provisions of HSWA:

Transport manifest certification statement: Effective September 1, 1985, HSWA Section 3002 (b) requires that generators certify that they have a program in place to reduce the volume or quantity and toxicity of hazardous waste to the degree determined by the generator to be economically practicable. Further, the proposed method of treatment, storage, and disposal employed to treat hazardous waste is that practicable method currently available to the generator which minimizes present and future threats to human health and the environment. Based on EPA's analysis of HSWA's legislative history, the Agency does not believe that it has the authority to dictate the content of these certifications.

Onsite permit condition requirement: Effective September 1, 1985, HSWA Section 3005 (h) requires that, for any permit issued under this section for the treatment, storage, or disposal of hazardous waste on the premises where the waste was generated, generators certify annually that they have a program in place to reduce the volume or quantity and toxicity of hazardous waste to the degree determined by the generator to be economically practicable. Furthermore, the proposed method of treatment, storage, or disposal is that practicable method currently available to the generator which minimizes present and future threats to human health and the environment.[36]

Inclusion of reporting requirements on Biennial Reports: Generators must include in their biennial reports a narrative statement regarding efforts undertaken to reduce the volume and toxicity of waste generated, along with a description of the changes in the volumes and toxicity of waste actually achieved during the year in comparison to previous years, to the extent such information is available for years prior to 1984. EPA is currently conducting a study to ascertain how the biennial reporting requirements might best achieve a consistency of data collection that enhances the future utility of these reports.

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[36] 50 FR 28734, July 15, 1985

Monitoring of compliance with the certification signatory requirement: Following the HSWA change to the transporter manifest, EPA's enforcement responsibility has been concerned with generator compliance with the signatory requirement. The amendment to the transporter manifests, as interpreted by the Codification Rule, limits EPA to enforcing compliance with the certification and signatory requirements. As stated below in the *Federal Register* (50 FR 28734), EPA does not believe that this requirement provides authority to intrude into industrial production process decisions.

> The amendment does not authorize EPA to interfere with or to intrude into the production process by requiring standards for waste minimization; rather, it specifically provides that the substantive "determinations" of "economically practicable," and "practicable methods currently available" are to be made by the generator in light of his own particular circumstances. Thus, from an enforcement perspective, the Agency will be concerned primarily with compliance with the certification signatory requirement. Each generator subject to the waste minimization requirement should make a good faith effort to minimize the amount and toxicity of waste generated and to select a means of treatment, storage, or disposal most likely to minimize the present and future threat to human health and the environment.[37]

Responses to specific inquiries from generators: Although EPA is not authorized through the waste minimization certification to interfere with or intrude into the generator's production process, each generator subject to the waste minimization requirement may seek EPA clarification on waste minimization practices by letter to the Agency (see Appendix E for copies of relevant correspondence).

Development of an Environmental Auditing Policy Statement. The Agency has adopted a policy with respect to environmental auditing which seeks to strengthen compliance with environmental regulations and to improve management controls by supporting conventional Federal, State, and local government oversight. This policy encourages regulated parties to conduct comprehensive audits to document how well environmental practices are established. One of the values of a comprehensive audit may be in the discovery of other previously unknown and unregulated risks in the management of a generator's waste. Such an audit could help a generator identify other waste minimization opportunities. For example, environmental audits may evaluate the extent to which hazardous waste management systems exploit source reduction, recycling, or reuse of wastes wherever practical, or "substitute materials or processes to allow use of the least hazardous substances feasible."[38]

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[37] 50 FR 28734, July 15, 1985

Technical and Financial Assistance

In the area of technical and financial assistance, EPA's role has been principally one of providing financial support through a number of EPA programs to promising State waste minimization efforts. It also provides research support for developing technologies that might facilitate waste minimization by selected industries. A limited amount of financing has been used to encourage States to continue with or to develop their own programs.

The Office of Solid Waste provides technical and financial assistance to States through State grants. The short-term strategy of the Office of Solid Waste to implement HSWA recognizes that "EPA must make better use of interest groups, trade associations, the Regions and the States in explaining regulations requirements,...where compliance with regulations is technically complex,... EPA and the States should make plans for providing adequate technical assistance and technology transfer."[39] Moreover, the draft strategy emphasizes that: "One area of need for technical assistance is educating small business on techniques for minimizing waste."

Congress has allocated $4.75 million in supplemental grant funding to the EPA Regional Offices for State and local government hazardous waste management activities. Distributed according to each Region's proportional share of the total Fiscal Year 1986 RCRA base State grants, the supplemental monies may support:

- Activities related to State or local government development of innovative waste management activities that will reduce dependency on land disposal; and

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[38] 51 FR 25010, July 9, 1986

[39] *Draft: Hazardous Waste Management Strategy Office of Solid Waste.*, USEPA, Office of Solid Waste, Washington, D.C., April 1986.

- Activities related to State or local government hazardous waste management efforts that accelerate issuance of permits to new or expanding hazardous waste management facilities.

Grants will be awarded and managed by the Regional Offices and are to be awarded with a 10 percent matching requirement, which grantees may fulfill with cash or in-kind services.

Eligible activities include:

- Conducting outreach or education activities in support of EPA Small Business Initiatives and increased Small Quantity Generator compliance with HSWA;
- Implementing a local or Regional collection, transfer, and transport system to handle Small Quantity Generator waste;
- Analyzing generator waste streams for evaluation of onsite treatment potential toward reduction of volume or toxicity of waste or potential for reuse or recycling;
- Analyzing generator processes for potential volume or toxicity reductions; and
- Conducting analysis of waste streams in a particular industry, geographical area, or demographic context for potential development and actual establishment of a waste exchange program.

The Office of Research and Development's Small Business/Small Quantity Generators' Research Program provides financial support for research and information activities of agencies or associations working with small businesses. Funding sources include the following:

- Funding is partially provided to the Governmental Refuse Collection and Disposal Association clearinghouses for information on waste management options in association with State agencies and industry groups. Federal support for this project will be available for two years, after which the program will be self-supporting.
- Continued support is provided to State technical assistance and educational programs for applied research on waste minimization that can be implemented by other State programs. Funding is currently provided to North Carolina and Minnesota.

The Office of Research and Development also supports research and development of recycling technology and clean manufacturing processes at the Industrial Waste Elimination Research Center at the Illinois Institute of Technology.

Other Office of Research and Development activities providing research and technical support include the following activities:

- The regional support services (RSS) staff serves as a clearinghouse for the Regions and the States by fielding requests for technical information or technology transfer that cut across media or disciplines within the EPA. It provides assistance to the States by fulfilling requests that require development of new information or integration of unpublished information toward resolution of new problems, and supporting the waste minimization activities of the States through cooperative agreements with the State-focused associations, such as the National Governor's Association (NGA).
- The Hazardous Waste Environmental Research Laboratory (HWERL) is undertaking research on waste reduction and recycling technologies. HWERL recently studied waste minimization practices of the printed circuit board industry and is currently conducting eight waste minimization audits.
- The Office of Research and Development (ORD) administered funding for applied research recently conducted for OSW in cooperation with the Tufts University. The Tufts Center for Environmental Management conducted a foreign practices study which profiles current waste minimization activities in Canada, Japan, and Western Europe.

Information Sharing and Management

EPA can draw upon several existing sources of information in order to further the dissemination and sharing of knowledge about hazardous waste generation and waste minimization policy among EPA, States, other Federal agencies, and industry. Mechanisms for information sharing include conferences, workshops, biennial reports of the waste generators, survey data bases, and census data.

Following the success of the 1985 conference entitled "Waste Reduction—the Untold Story" at Woods Hole, Massachusetts, at which representatives of 22 large companies discussed their waste minimization activities, EPA sponsored a second waste minimization conference entitled "Waste Reduction—the Continuing Saga" on June 4-6, 1986. Assistance was provided by Tufts University. The program was expanded to include waste minimization activities by small and medium-sized generators.

During 1986, EPA co-sponsored and assisted in coordination of the third workshop for State Waste Reduction Programs under the leadership of the North Carolina Pollution Prevention Pays Program. These semiannual workshops provide a forum for the exchange of current information and resources to further State efforts in waste minimization. Approximately 20 to 30 State programs are represented at each meeting.

During 1986, the staff of the Office of Solid Waste and the Office of Policy, Planning, and Evaluation conducted presentations on waste minimization at the following events:

- Hazardous Materials Conference in Atlantic City, New Jersey;
- Annual Meeting of the American Institute of Chemical Engineers in Chicago;
- "Alternative Technologies to Hazardous Waste Management," a conference sponsored by the Engineering Foundation;
- Government Institute course on Hazardous and Solid Waste Minimization;
- Pollution Prevention Pays: the Tennessee Approach;
- The Air Force Logistical Command First Annual Hazardous Waste Minimization Conference; and
- A meeting of the American Wood Preserver's Institute.

EPA provides support to the Environmental Audit Roundtable, which focuses on the activities of industry. Quarterly meetings are held in Washington, D.C., to address topics such as waste audits and offsite waste reduction activities. To encourage environmental audits by Federal facilities, EPA has provided initial coordination and support for a Department of Defense/EPA Memorandum of Understanding, which is currently under discussion. EPA's special purpose mailing list on Environmental Auditing includes over 900 names; most Fortune 500 companies are represented on this list, as are over 100 Federal facilities. By August 1986, EPA had also issued over 2,000 copies of the general policy statement on Environmental Auditing. Several EPA offices are currently reviewing a draft Federal facility compliance strategy by EPA's Office of Federal Activities that encourages environmental auditing. Environmental audits and waste minimization programs are encouraged and co-sponsored by the Office of Enforcement and Compliance Monitoring and the Office of Federal Activities at the regular meetings of the Federal Facility Environmental Managers

Generators and treatment, storage, and disposal facilities (TSDFs) are required to report waste generation and disposal information on a biennial basis to EPA. The information assists the Agency in its evaluation of the volume, type, and disposal and treatment of waste generated by industry in the country. The Agency is studying the data from the reports and may eventually revise the biennial report in order to include more detailed information on waste minimization efforts by generating facilities.

Several existing data bases provide a current picture of the Nation's waste generation. As noted in the first section of this chapter, the information comes from surveys of large and small quantity generators and from industrial data bases. Two of the most comprehensive data bases are the RIA Mail Survey and the National Small Quantity Generator Survey. Although the data from the RIA Mail Survey are now over five years old, the survey has provided useful information on how individual facilities are handling the waste they generate. The more recent (1985) Small Quantity Generators' survey provides information similar to the RIA Mail Survey on the activities of the small generator. The Industrial Studies Data Base (ISDB) has been developed from questionnaires sent to industries under Section 3007 of RCRA. It contains information from 12 different industrial categories. The ISDB differs from the other surveys in that it contains information on the various processes within each of the industrial categories surveyed. Despite some limitations (e.g., the age of the data, reporting errors), these data bases have been extremely helpful in the assessment of current waste generation and treatment/disposal activities. If they are continuously updated, the surveys and industrial data could be accurate measures of the trends in waste generation and treatment by industry.

Census data provide another valuable source of information. Although the Bureau of Census does not collect information on waste generation by industry, the Census does provide useful economic data as well as information on the number of establishments, plant size, production, raw material consumption, revenue, and regional location. Economic and industry-specific knowledge, when combined with other data sources described above, can extend the knowledge base that EPA and other Federal and State agencies need to make informed policy decisions about future waste minimization efforts.

Additional authority for the development of useful information in furthering waste minimization objectives may be forthcoming under CERCLA reauthorization. The proposed bill contains a new act which requires fairly comprehensive inventories of all "hazardous chemicals." The new act builds upon reporting requirements that already exist under OSHA regulations for Material Safety Data Sheets. This act will also expand the list of substances subject to emergency notification and require the development of a new list of toxic chemicals that will be subjected to reporting requirements. This bill will be in addition to the provisions of the current CERCLA legislation that requires reporting in Section 103(a)(14) only for specifically listed "hazardous substances." The act will require information with respect to each toxic chemical at a facility subject to the requirement, concerning:

- The general use of the toxic chemical;
- An estimate of the maximum amount of the toxic chemical present at the facility at any time during the preceding year;
- For each waste stream, the treatment and disposal methods used and the efficiency of treatment; and
- Annual quantity of toxic chemical entering each environmental medium.

In sum, these mechanisms afford a significant basis upon which to develop a comprehensive overview of the use, movement, and fate of all chemicals and wastes of concern and to determine the changes resulting from altered economic and regulatory conditions. A suggested strategy for collecting the necessary data is described in Chapter 4.

Other EPA Activities Potentially Relevant to Waste Minimization

EPA currently is developing a variety of regulatory and analytic mechanisms in response to existing environmental legislation. This section reviews some existing EPA activities that could be redirected and integrated into the core of the hazardous waste minimization program at a later date.

Examination of RCRA program permit process: The Permit Process and Regional State Operations Workgroup of the Office of Solid Waste, Hazardous Waste Implementation Task Force, has recently completed its examination of the RCRA permit program to identify significant program problems and weaknesses and to develop recommendations for improving the program's structure, substance, and management. The workgroup's draft report recognizes that the time and expense involved in getting a final RCRA permit can delay the development of new waste treatment capacity. While many aspects of the HSWA have created strong incentives for waste minimization, some aspects of the new requirements related to permit procedures for onsite treatment, storage, or disposal are perceived by generators to inhibit waste minimization but are in fact designed to inhibit only *unsafe* waste minimization.

Suggested potential solutions include:

- Acceleration of the permit process for facilities with regard to the addition of new disposal or treatment capacity;
- Publication of treatment standards that focus on the treated material (to ensure that it is no longer hazardous) rather than the treatment technique, *per se;* and
- Continued EPA work group examination of the issues concerning onsite recycling and hazardous waste treatment such as the issuance of waste generation permits.[40]

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[40] *Draft Final Report, Hazardous Waste Implementation Task Force Permit Process Workgroup,* USEPA, Office of Solid Waste, Permits and State Programs Division, Washington , D.C., March 14, 1986.

National survey of commercial hazardous waste treatment, storage, and disposal facilities: During 1986-87, the Office of Solid Waste plans to conduct a survey of hazardous waste facilities in which questionnaires will be sent to a sample of commercial and private facilities that store, treat, recycle, or dispose of hazardous wastes. One major objective of the survey is to develop a categorization of the types of treatment and recycling practices that hazardous waste facilities use based on a facility's capacity and operating costs. The questionnaire is designed to elicit information on specific types of treatment and recycling practices, for example, solvent recovery systems including fractionation, batch still distillation, solvent extraction, and thin film evaporation.

Foreign practices study on hazardous waste minimization: Completed in July 1986, this study was conducted by of the Center for Environmental Management at Tufts University and funded by a grant from EPA.[41] To supplement this report to Congress on the feasibility of Federal initiatives in waste minimization, the foreign practices study examined activities in Japan, Canada, the Federal Republic of Germany, the Netherlands, Denmark, and Sweden. The study focused on government laws and programs affecting waste minimization as well as the efforts of four industry sectors: organic and inorganic chemicals, textiles, electroplating, and electronics.

The study found that most of the countries rely on a two-tier governmental approach to advance waste minimization. Standards and pollution control policies are developed at the Federal level. The regional government (State, province, or prefecture) administers the cooperative managerial aspects of the waste minimization program.

Central to most of the countries is a fairly aggressive role on the part of government to working cooperatively with industry in improving waste minimization. In all countries, industrial managers and government officials most commonly credited economic or market forces with driving waste minimization. Corporate public image is often noted as an important motivator. The cooperative relationship between industry and government means that the government agencies are frequently less regulatory in their approach to waste reduction. Industry managers are also more likely to anticipate environmental protection issues and comply with plans as developed.

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[41] *Foreign Practices in Hazardous Waste Minimization*, USEPA, Office of Solid Waste, Washington, D.C., June 4, 1986.

In all countries surveyed, there are public programs and guidelines for the encouragement and installation of waste reduction, recycling, waste exchange, and installation of low pollution technologies. However, none of the countries directly mandates any form of waste minimization or establishes performance standards. Viewed in terms of generic categories, all countries use some combination of the following policy options. Tax and economic incentives are frequently used together, as are technical assistance and research and development assistance. Most countries have some kind of waste exchange in operation. Plans and permits are less frequently used but are important where they are employed. Some topics that are frequently discussed in the U.S., such as the influence of tort liability and the feasibility of performance standards, are rarely considered in the six countries. Similarities which these countries do share with the U.S., however, relate to difficulties associated with the evaluation of program effectiveness. There are no comprehensive data collection systems. No detailed information is collected on a systematic basis concerning waste per unit product generation rates, or the degree to which industries or firms conform with suggested waste minimization guidelines or procedures.

In Europe, much of the impetus for waste management comes from the efforts of the European Economic Community, which has frequently characterized waste minimization as a goal of member countries. The Third Environmental Action Program of 1981 emphasized the inclusion of environmental protection into all aspects of economic and social development. The program directed that the greatest emphasis be placed on prevention of waste generation, on designing products to facilitate recycling, and on waste management that progressively substitutes reuse for disposal.

Computerized hazardous waste management model: EPA's Regulatory Integration Division has developed an automated hazardous waste management model that may prove useful in State planning efforts for waste minimization. This model was developed to assess the risks inherent in current hazardous waste management practices and to evaluate potential changes in risk resulting from alternative waste management strategies. New

England was selected as the first region for development of this tool. The current model integrates information on waste volumes and types, transportation routes, waste management facilities, exposure probabilities, and health effects.

Effluent guidelines revisions to encourage recycling: In keeping with the mandate to clean and protect the Nation's water, EPA's Office of Water (OW) is reviewing effluent limitations on wastewater discharges from various pollutants in specific industrial categories under the authority of the Clean Water Act. In making these determinations, OW evaluates various technical alternatives in terms of their environmental impacts and technical feasibility. Included within these assessments are process modifications that reduce water use, minimize wastewater generation, and substitute chemicals to reduce pollutant concentrations in wastewater.

Also included in the OW assessments is the impact on possible intermedia pollution shifts associated with effluent guideline compliance. In particular, OW's Industrial Technology Division is conducting a study to identify intermedia effects associated with discharges of volatile organic compounds (VOCs). In some cases, technologies to treat the effluent may transfer the problem of contamination by hazardous constituents to other media, such as air or solid waste. In the case of VOCs, OW is coordinating with the Office of Air and the Office of Solid Waste in an attempt to adopt a standard that minimizes the tradeoffs between water effluent and air and solid waste.

United Nations Economic Commission for Europe: EPA participates in international efforts to minimize wastes produced by industry. The United Nations Economic Commission for Europe (UNECE) currently provides a compendium of low and non-waste technology to serve as a means of promoting process technology changes that eliminate or reduce wastes, energy usage, or natural resource usage. The EPA has supported this effort by contributing five descriptions to the compendium and assisting the UNECE staff with other information as needed

Use of Toxic Substances Control Act (TSCA) for waste minimization: TSCA, which took effect January 1, 1977, charged EPA with protecting human health and the environment from unreasonable risks of injury from toxic chemicals. There are three general sections of TSCA that could be used to support various waste minimization needs.

To support information gathering, TSCA Section 8 authorizes EPA to require reporting and recordkeeping by industry on chemical substances and mixtures. Specifically, Section 8(a) provides authority for EPA to promulgate rules that industry must follow in order to maintain records and report certain production, use, and exposure related information to the Agency. Such information could be collected through the recently proposed Comprehensive Assessment Information Rule (CAIR), for example, which improves the data gathering procedures for providing information on existing chemicals or via the development of other chemical specific TSCA Section 8(a) rules.

To regulate the introduction or importation of new chemical substances, TSCA Section 5(a) requires EPA to review new chemical substances prior to their manufacture. Manufacturers are required to provide EPA with a premanufacturing notification (PMN) 90 days before beginning manufacture for any chemical substance not included on the TSCA Chemical Substances Inventory. EPA reviews and evaluates the potential risk posed by the new substance and determines whether controls are appropriate, whether additional data are needed, or whether production should be prohibited. The Office of Toxic Substances and OSW are conducting a review of how to use the PMN program as an incentive to incorporate waste minimization techniques in the production of new chemical substances. EPA is currently planning to prepare a New Chemical Information Bulletin that would provide guidance to submitters of PMNs by stating that EPA will consider waste minimization practices in its review of relative risks of new chemical substances.

TSCA Section 6 could be used to limit the disposal of certain types of hazardous wastes through specification of those chemicals that cannot be disposed of and by encouraging generators to undertake treatments other than land disposal. TSCA Section(6)(a) authorizes the Administrator to develop regulations to prohibit disposal of a substance or mixture by its manufacturer or processor. While EPA does not usually impose chemical-specific treatment, storage, or disposal methods for a particular waste under TSCA, it can limit the number of options that are available and by doing so, pressure a generator into using preferable treatment methods.

TSCA Section 6(b) may also provide some control. Section 6(b) states that if the Administrator has a reasonable basis to conclude that a particular manufacturer or processor is manufacturing or processing a chemical substance or mixture in a manner that unintentionally causes the chemical substance or mixture to present or which will cause it to present an unreasonable risk of injury to health or the environment, the Administrator may (1) require the manufacturer or processor to submit a description of the relevant quality control procedures followed and (2) if the quality control procedures are inadequate, require the manufacturer or processor to revise such quality control procedures to the extent necessary to remedy such inadequacy. This second provision may be more difficult to implement but could conceivably impose on a manufacturer requirements that ultimately minimize waste.

Determining whether a particular risk is "unreasonable," however, is very difficult. Under TSCA, EPA must take into account the hazard presented, the magnitude of human and environmental exposure, and the benefits and economic consequences of the proposed regulations. If it is found that the impact on the economy from regulatory control outweighs the risk of harm to human health and the environment, EPA will not find the risk unreasonable. It might therefore be necessary to consider control alternatives under other statutory authorities.

Chapter Three

EVALUATION OF WASTE MINIMIZATION OPTIONS

Many options are potentially available for use as part of an EPA waste minimization program. Congress has directed the Agency in HSWA to address specifically three categories of actions:

- Standards of performance
- Changes to RCRA, including
  — Modifications to Section 3002 Generator Standards
  — Modifications to Section 3005 Permit Standards
- Management practices

In addition, the Agency has identified a variety of other approaches to waste minimization, some of which would require new statutory authority, and some of which could be implemented on the basis of existing Agency authority.

The purpose of this chapter is to present and evaluate these options. The first section below describes the criteria used by EPA to make evaluations. The second section presents an overview of the options themselves under four headings: Standards of

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Performance, Modifications to RCRA, Management Practices, and Other Available Options. Detailed evaluations of the options are contained in Appendix A of this report.[1]

Criteria for Evaluating Waste Minimization Options

As Chapter Two discusses, the issues involved in designing waste minimization programs are complex. As the many new provisions of HSWA are implemented, particularly the land disposal restriction program, many critical aspects of the country's hazardous waste regulatory environment will be in a state of flux. To meet HSWA's deadlines and requirements, EPA is facing heavy internal demands on its time and staff resources. Simultaneously, States are developing their own programs. In the private sector, additional commercial treatment capacity must be installed, and large numbers of firms and plants not previously regulated will now have to be issued, and comply with, RCRA permits.

Waste minimization options must therefore be evaluated, not only in terms of their effectiveness in minimizing waste, but also in terms of their feasibility of implementation. Thus, in addition to effectiveness, the evaluation should consider the following.

- What the private sector costs and other impacts would be on generators in light of their already existing need to accommodate the many new requirements of HSWA ;
- What the internal impacts would be on EPA for each option, in terms of new research requirements, additional regulatory development burdens, and implementation and enforcement burdens; and
- What burdens would be put on the States.

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[1] *Waste Minimization Issues and Options* , Office of Solid Waste, USEPA, Washington, D.C., October 1986. The Agency identified a number of options that are not discussed in this chapter. These have been dropped from active consideration at this time for the various reasons described in Appendix B of this report.

The criteria used to evaluate the options have therefore been put under three general headings:

- **Technical effectiveness:** How well does the option meet the goals of waste minimization?
- **Impacts on industry:** What will be the costs and other burdens of compliance with each option?
- **Implementation issues:** How will this option be implemented, and what will the burdens be on EPA and State resources?

Each of these areas is discussed separately below. As is evident from the detailed discussions contained in Appendix A, the information necessary to answer many of these questions properly is often unavailable.

Technical Effectiveness

The first consideration in evaluating any option is the degree to which it achieves the objectives set by Congress for minimizing the volume or quantity and toxicity of wastes generated, or which would otherwise be sent to land disposal.

Volume reduction: Volume reduction is of key concern for any waste minimization option and will be particularly important in the short term, especially for those firms that must rely on offsite commercial treatment facilities. While the overall goal of waste minimization is to produce significant aggregate reductions in the total volume of hazardous waste produced each year, it may often be important in the short term to direct minimization efforts to those industries or waste streams for which treatment capacity is in shortest supply. In assessing the effectiveness of a particular option in terms of potential for reducing waste volume, pertinent questions include the following:

- What proportion of total national waste volume could it reduce?
- What proportion of the waste from the affected industries or waste streams might be reduced?

Toxicity reduction: The effectiveness of an option in achieving toxicity reduction may be harder to estimate than its effectiveness in reducing waste volume, but the questions involved are similar to those asked in regard to volume reduction:

- To what degree would the option tend to reduce the toxicity of a particular waste stream?
- Would toxicity reduction interfere with volume reduction?

Other technical effectiveness issues: There may be additional criteria under this heading that are important to some options and not others. This section will allow for further detailed discussion of the option and will focus on issues such as the following.

- **Side effects and intermedia transfers:** Important technical considerations in the evaluation of any option are the relationships between volume reduction and toxicity reduction and the possibility of unwanted transfers of pollution from one location or medium to another. As pointed out in Chapter Two, for instance, volume reduction may produce more concentrated and, therefore, possibly more toxic, wastes. Conversely, toxicity reduction may involve dilution of wastes, increasing their volume. Certain options may appear to minimize waste effectively, but in fact may only be transferring pollution to the air or water. Questions about such concerns include:
    - — Will this option tend to produce undesirable side effects in terms of the volume or toxicity of hazardous waste reduced?
    - — Will it produce adverse effects in environmental media other than those affected by hazardous waste management?
- **Transaction costs:** Some waste minimization options, such as those of waste exchanges, merely facilitate access to information, i.e., they reduce the transaction costs associated with improving the management of hazardous wastes. Evaluating the technical effectiveness is, thus, quite subjective. Pertinent questions include:
    - — What waste minimization transactions does this option affect, and what specific problems is it aimed at correcting or ameliorating?
    - — How effective will it be in its stated objective?
- **Measuring results:** A key factor in the technical effectiveness of any option is the degree to which its success can be predicted in advance, or measured

after implementation. Standards of performance, for instance, might have fairly easily predictable and specific effects on the composition and volume of wastes produced. On the other hand, it may be extremely difficult to estimate the effects produced by various types of incentive programs (such as loans, grants, or technology transfers), or options aimed at reducing transaction costs (information hotlines, waste brokers). It is not necessarily critical to be able to measure the effectiveness of an option, but it may be an important factor to consider, especially if the costs of an option are high. Questions include:

— Is it possible to measure the effectiveness of the option?

— If it is measurable, what are the relevant variables and what methods would be employed?

Impacts on Industry

There are a variety of potential burdens that a particular waste minimization option might put on industry, especially since several options under consideration could intrude significantly further into the details of production processes than traditional environmental programs have done. Compliance costs are usually the first concern. Other factors include equity considerations, confidentiality issues, and incentives for noncompliance.

Economic impacts: The costs of complying with a particular waste minimization option can be negative as well as positive since waste reduction often *saves* rather than costs money. Cost questions that might be asked are the following:

- What are the capital costs associated with the option? (These may be incurred with major process modifications.)
- What are its operation and maintenance costs? (These can include changes in feedstock requirements, energy use, transportation expenses, and so forth.)
- What is the reporting burden? (The costs of reporting to EPA or the State may be considerable for some options.)

Equity: Because some industries, and some firms within industries, have already voluntarily begun to minimize their wastes, equity among firms can be an important consideration in determining the desirability or feasibility of a particular option. Some options may, in effect, penalize industries that have already reduced their wastes. Others may unnecessarily interfere with the current competitive structure of markets. Pertinent questions include the following:

- Do costs of compliance with this option vary significantly across firms or industries with respect to size, category, location, or some other factor?
- Does the option tend to alter markets for products, or to affect the current competitive relationships among firms or industries?
- Does the option risk violating the legitimate confidentiality of proprietary processes?

Incentives for noncompliance: Some waste minimization options could create strong incentives for noncompliance of one type or another, ranging from nonparticipation or nonreporting to deliberate violation of regulatory requirements (falsification of records, illegal dumping, etc.). Questions include:

- Does this option encourage noncompliance?
- Are enforcement tools adequate to compensate for noncompliance incentives?

Implementation Issues

A wide variety of issues are of concern here, including all aspects of developing, implementing, and enforcing the option. Also important are the effects of the option on State programs, its effects on other environmental programs, its flexibility in responding to changing circumstances, its acceptability to the public, and its effects on changes in industrial technology.

Legislative authority: It is important to determine what changes will be necessary, if any, in the legislative authority in order to implement each option. The types of authority that the Agency will need depends on the option itself. In some cases, the type of additional authority could be provided by a simple ruling change (e.g., waste audits), whereas in other cases it may require extensive Congressional legislation. The type of questions that need to be answered are:

- What are the types of legislative changes that will be necessary in order to implement the option?
- Is additional legislative change necessary or can modifications be made to existing authority?
- Would a simple ruling change instead of additional legislative authority be a more appropriate method to extend the Agency's ability to implement the option?

Time required for implementation: Timing is an important variable in the evaluation of the options. For some options, implementation is contingent on the outcome of other options or regulatory policies. It may be that an option will not take long to implement, but that implementation cannot occur until after the other options or policies take effect. Questions that need to be addressed are:

- What is the reasonable length of time it would take to develop the option?
- Are there delays or contingencies that might otherwise hold up the implementation of the option (e.g., land disposal restrictions)?
- How long after implementation would the option be expected to influence waste minimization?

Appropriate target industries: Not all the options are appropriate for every industry or for every waste stream. It may be necessary to identify those industries and waste streams that best meet the goals of waste minimization. Issuing performance standards, for example, might be a satisfactory means of minimizing waste, but the type of standard would likely have to vary depending on the type of industry and waste stream(s) involved. The important questions are:

- What are the most suitable industries for the option?
- What waste streams within a targeted industry are best adapted to the option?
- Will targeting industries interfere with implementation of other options?

Costs of development and implementation: These include all direct costs to the Agency for conducting research, gathering and analyzing data, writing regulations, writing permits and enforcing regulations, or any other expenses necessary under the option. If grants or awards were selected, for example, costs would include the amount of the grants or awards. Questions include:

- What would the intramural staff requirements be, at Headquarters and in the Regional Offices?
- What would extramural costs be (data gathering/data automation, research, etc.)?
- Are there any special enforcement considerations (e.g., new categories of regulated parties, history of poor compliance in a regulated sector)?

Other Considerations

This final category covers criteria or concerns that may not be germane to all of the options. It is a catch–all section in which it is possible to evaluate options that have unique aspects. Additional criteria include: flexibility in implementation, impacts on States, public perception, effects on other environmental programs, and effects on innovative technology.

- **Flexibility in implementation:** Flexibility may be an important issue, particularly since the context in which waste minimization is being enacted is still fluid. Options that have strict administrative requirements (such as standards of performance issued as conventional regulations) are likely to be considerably less flexible than others (e.g., performance standards enacted as phasedown permits). Questions include the following:

  — To what degree can enactment of the option be negotiated with involved parties?

  — Are formal administrative variances and other procedures required to modify the specified conditions?

- **Impacts on States:** States are already an integral part of the hazardous waste management system. Their involvement in waste minimization will likewise be important. Questions include the following:

- Does the option interfere with or duplicate waste minimization or hazardous waste management policies already established by the States?

- What costs and staff burdens would the options put on the States, and how would these expenses be defrayed?

- Is voluntary State involvement required in order for the option to work?

- Must State involvement be uniform across the country for the option to work?

- **Public perception:** Because the whole subject of hazardous waste management is of such concern to the general public, waste minimization options should be compatible with public opinion. Some of the options under consideration may be more difficult for the public to accept than others: for instance, the public has always been skeptical of environmental programs that appear to operate on a "pay-to-pollute" basis. Therefore, although options like phasedown permits are considered to be an economically efficient way to reduce waste generation, the public may not endorse a program where companies buy permits that allow them to generate hazardous materials. On the positive side, it may also be important to consider whether a given option reduces public anxiety about hazardous waste. Many companies have already embarked on voluntary waste minimization programs partly to improve their public environmental image. The key questions are summarized below.

- Is this option compatible with public opinion?

- Does it allow industry to take credit for voluntary actions taken to reduce hazardous wastes?

- **Effects on other environmental programs:** Some waste minimization options may require extensive internal cooperation among EPA programs. An example would be the use of the Effluent Guidelines program to restrict hazardous waste generation. If such cross program relationships are important, they should be identified in advance. The type of questions that need to be answered are listed below.

- Does this option shift any wastes or risks out of the jurisdiction of the hazardous wastes system and into that of another program?

  - — If so, have such shifts been made deliberately, and are they in the overall best interests of protecting human health and the environment?
  - — If not, can they be mitigated or corrected?

- **Effects on innovative technology:** Some options may tend to stimulate technological innovations in reducing the generation of hazardous waste; others may tend to stifle innovation and lock in existing technology. Major questions would be:
  - — Would this option have a positive or a negative effect on technological innovation?
  - — If so, would such effects have been noted in the development of the option?

Discussion of Options

The following sections summarize the detailed evaluations of each of the options reviewed for this report to Congress. Not all of the questions raised above are dealt with below; Appendix A contains a more extensive analysis of the various factors considered. The sections below highlight the issues that have emerged as most critical in the detailed evaluations.

To aid in the comparison of options, Figure 3-1 presents a timeline summarizing the schedule for implementing each option. Where additional Congressional authority might be needed before the Agency could proceed with a particular option, it has been assumed that authorization will be forthcoming by 1988. Time is allocated for such tasks as data gathering, research, regulatory development, and regulatory implementation. Where the desirability or feasibility of an option is dependent on market reactions to any of the scheduled land disposal restrictions, the Agency has estimated that all necessary data could be available within two years of promulgation of a rule (although it could take longer, in some cases, either for the new rule to change behavior, or for the gathering of data to trace such changes).

As a further aid for comparing the options, Table 3-1 briefly summarizes the pros and cons of each option, as revealed by the evaluations. These represent the Agency's

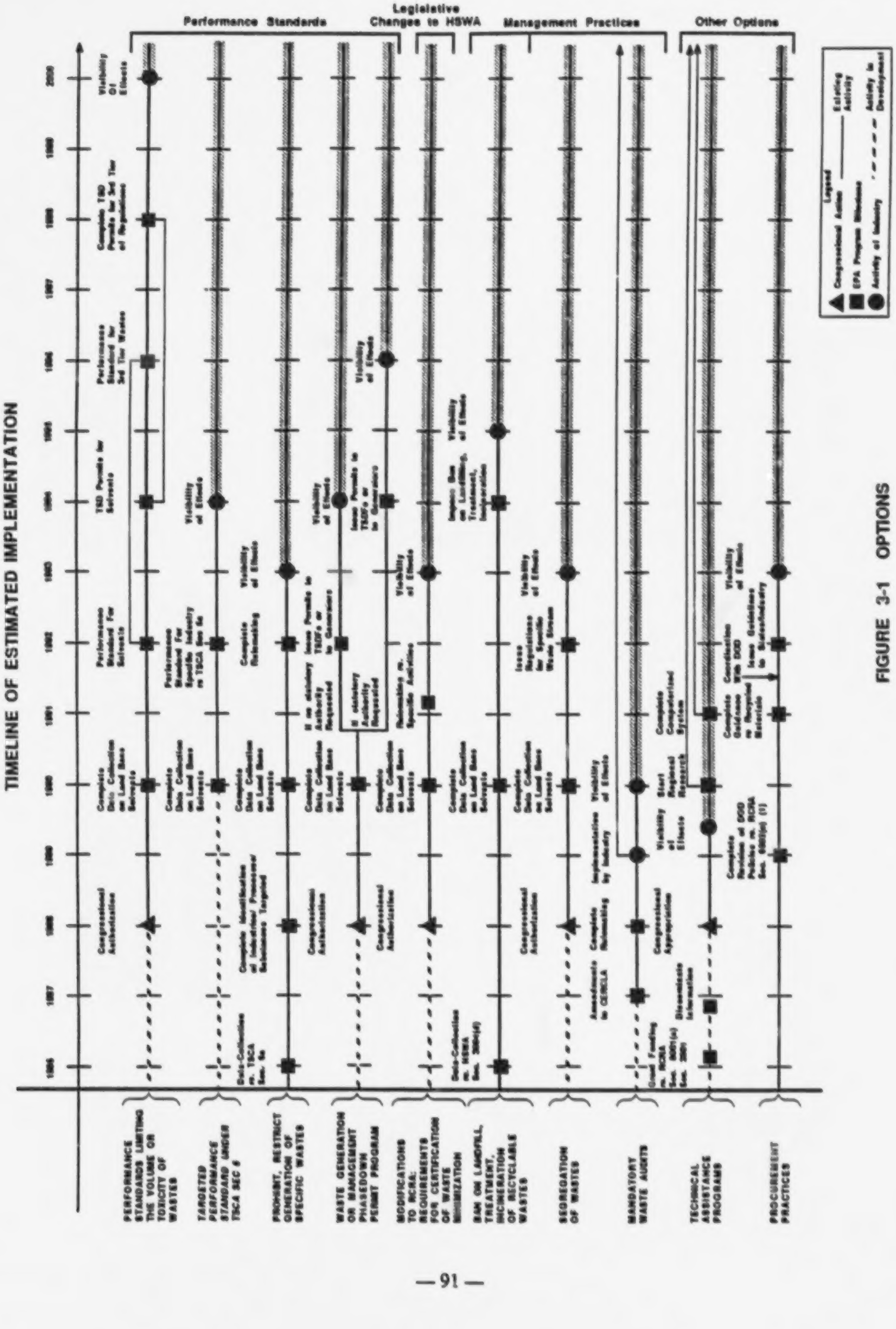

FIGURE 3-1 OPTIONS

Table 3-1

Summary of Advantages and Disadvantages of Waste Minimization Options

Option	Advantages	Disadvantages
Performance Standards Limiting the Volume or Toxicity of Wastes	Directly mandates controls. Generally acceptable to public. Establish clear, numerical goals. Define technology-based, defensible limits. Suitable for industries producing high volume or high toxicity waste streams. Provide incentives to industry to invest in alt. technologies. Encourage polluters to pay for pollution reduction.	Long development time. Intrudes into industry operations. Substantial information requirements. High costs of development/implementation. Potential for many variances. Difficult to enforce. Adverse impact on construction of new facilities. Inflexible to industries that have significantly minimized wastes. Potential for adverse effects. Significant potential for litigation. Imposes significant costs on States. Resource intensive — economically inefficient approach to waste minimization.
Prohibit or Restrict Generation of Specific Wastes	Direct application of source reduction regulatory program. Based on existing authority of TSCA 6(a). Likely to be acceptable to public. Consistent with HSWA and RCRA intent.	Significant information requirements. May encourage illegal disposal. Potential for increased discharge to other media . Controversy over rulemaking may significantly delay implementation. May be viewed as government intrusion into manufacturing processes. High costs of implementation.
Waste Generation or Management Phase-down Permit Program	Sensitive to market mechanisms; economically efficient. Mandates waste volume reduction. Best targeted to industries with homogeneous waste streams. Provides incentives to generators to develop new technologies.	Difficult to enforce. Potential for large wealth transfers. Need for EPA to minimize market uncertainties. Potentially expensive to develop permit system. Potential long development time. Potential negative public perception.
Modifications To RCRA: Requirements for Certification of Waste Minimization	Built on existing requirements. Increase industry capacity to increase WM "voluntarily." Improve EPA administration of HSWA. Provide State tech. assist. programs with better information. Modest administrative costs to clarify guidance. Speed of implementation following Congressional authority.	Reporting burden on industry.
Ban the Landfilling, Treatment, or Incineration of Potentially Recyclable Wastes	Best targeted to highly toxic waste streams. Based on existing HSWA authority. EPA can choose to target waste streams or sites/generators. Sets clear numerical goals. Generally acceptable to public.	Very resource intensive. Difficult to enforce. Potential for many variances. Expensive to develop. Inflexible in distinguishing between industries with high vs. low volume recycling potential. Complex rulemaking.

Table 3-1

Summary of Advantages and Disadvantages of Waste Minimization Options

Option	Advantages	Disadvantages
Segregation of Wastes	May reduce volumes of wastes generated. Makes increased recycling feasible. Renders non-recycled waste streams easier to treat. Responsive to market mechanisms in selected industries. Several processes with substantial recycling potential.	Industry and site-specific feasibility will vary. Significant costs. Significant information requirements. Long development time. Significant enforcement costs. Imposes significant new costs on State programs.
Mandatory Waste Audits	Speed of implementation. Existing authority: Amendment to CERCLA. Moderate enforcement costs re: notification. Encourage targeted industries to self-police. Flexible requirements allows EPA to follow up case-by-case. Applicable to large volume or high toxicity target industries.	High enforcement costs if industry views it as a regulatory requirement. High enforcement costs to verify implementation by SQGs.
Technical Assistance Program	Support existing State program initiatives. Encourage industry to act voluntarily to minimize waste. Strengthen intragovernmental system. Require modest increases in expenditures. Support development of focused, centralized activity for States. Avoids duplication of State efforts. Speed of implementation following Congressional authorization.	Large-scale technical assistance programs are not traditional EPA activities. Would require positive and sustained internal and external commitment and support. Additional EPA staffing requirements. Incur new administrative costs for developing computerized information system.
Procurement Practice	Build on existing DOD waste minimization activities. EPA can use existing RCRA authority Section 6002. Voluntary, self enforceable.	Sign. cost of development for data collection, reproduction, substitution, and procurement of virgin materials; wastes associated with purchased products. Would require significant coordination with other agencies. Significant development time. Potential difficulty to measure policy effectiveness.

assessment of the feasibility and desirability of each option and are the basis of the recommendations for action presented in Chapter Four.

Each of the four categories of waste minimization options is presented below.

Standards of Performance

HSWA requires EPA to evaluate "standards of performance" as a general option for possible use in minimizing wastes through source reduction. As a concept, standards of performance have the distinct advantage of specifically restricting the quantity or toxicity of a waste that is generated, but their implementation requires direct government intervention in the activities of specific industries and facilities. While performance standards have been the primary mechanism for reducing air and water pollution, the standards for controlling pollutants in these media were generally based on end-of-pipe control technologies. Performance standards for minimization of hazardous waste, however, would depend substantially on internal process modifications. As such, they represent a significant departure from the existing philosophy and past practice of environmental regulation, which generally deals with the pollutants *after* they are generated.

The use of standards of performance to require waste minimization does not imply a single type of regulation. There are many possible variations in practice; the four most significant and practical have been evaluated for the purposes of this report. The common thread among the various approaches is that each would probably require changes in the production processes responsible for the generation of hazardous wastes. The options differ in their approaches to accomplishing the changes. One is in the classic command and control method, i.e., by dictating exact processes to be used in producing specific products or mandating specific amounts of reduction of waste on a per unit output basis. Adoption of such an option would require modifying RCRA to create a program similar in type to the New Source Performance Standards program under the Clean Air Act, or the Effluent Guidelines program under the Clean Water Act.

Other options that fall generally under the concept of performance standards include:

- Specific standards limiting the volume or toxicity of wastes based on authority under other programs to accomplish command and control type reduction in volume or toxicity of wastes; this is discussed below in relation to the use of TSCA Section 6.
- Phasedown permits to accomplish source reduction indirectly, by setting up a market that lets EPA set minimization targets overall; this would let the affected industry or industries determine which processes would be affected.
- Prohibit or restrict the generation of specific wastes; this would be similar to the basic performance standard option, but would be more selective. It might also rely on the use of TSCA Section 6.

Table 3-1 summarizes the pros and cons of each approach, based on the structured evaluation conducted using the criteria presented above. The sections below outline the reasoning behind these conclusions. A general approach is then suggested for determining how and when standards of performance might be adopted.

Traditional performance standards limiting volume and/or toxicity of wastes for generators: Performance standards are technology based, limiting the volume, concentration, and/or toxicity of a specific waste stream or toxic constituent generated per unit of industrial production. A performance standard could apply either to specific industrial categories, or to specific waste generating operations. Limits would be established for a specific waste, based on the existence of an internal process modification to reduce waste quantity or toxicity to the prescribed level. In the Agency's opinion, performance standards for waste minimization should not dictate that a specific technology be used, only that a specific generation level be met.

Establishment of performance standards to achieve waste minimization would require the enactment of legislative authority by Congress: neither RCRA nor HSWA provide EPA with authority to establish waste minimization requirements for generators. As noted earlier, under Section 6(a) of TSCA, EPA does have the authority to regulate a substance or waste stream that poses an "unreasonable risk of injury to human health or the environment."

The Agency believes that performance standards for waste minimization could be appropriate to those industries that produce high volume or high toxicity waste streams, and which continue to represent, after the imposition of the land disposal restrictions program, a significant risk to human health and the environment. Not all such cases, however, are appropriate targets for performance standards. An evaluation would first be required to determine whether there are economically feasible technological alternatives to current industry production or recycling practices. Industries using batch, rather than continuous processes, for example, are likely to be more difficult to control. And in some cases (e.g., solvents), treatment by incineration may be more effective and less costly than alternative source reduction approaches.

According to the data currently available, the organic chemicals industry (SIC 2869) is the largest generator of hazardous waste. Several industrial processes included under organic chemical manufacturing, such as the manufacture of acrylonitrile, epichlorohydrin, 1,1,1-trichloroethane, trichloroethylene, trichloroethylene/perchloroethylene, and vinyl chloride monomer, are carried out in a small number of very large plants. While these processes produce large volumes of wastes, the engineering analysis in EPA's technical support document concluded that these facilities have already significantly reduced their wastes. Because of the volumes involved, however, small percentage reductions could still result in substantial overall volume reductions.

Other industries with waste streams identified as highly toxic include dry cleaning and paint manufacturing. Once again, however, the waste streams involved, e.g., tetrachloroethane distillation residues from dry cleaning (F002), or methyl ethyl ketone spent solvents from paint manufacture (F005), are subject to the first phases of the land disposal restrictions, and practices may change as a result.

In some cases, whether or not an industry would be an appropriate target for performance standards may depend on available centralized treatment or recovery capacity and capability. The electroplating industry, for example, produces large volumes of metal bearing sludges (F006). Since most electroplating facilities are quite small, substantial process changes to reduce waste generation are not likely to be financially feasible, but centralized ion-exchange metal recovery waste processing plants to which electroplaters could send their wastes might substantially reduce the costs of recovery, making possible a degree of waste reduction and recycling that could not otherwise be achieved by individual electroplating plants.

It is impossible at this time, however, to predict the extent to which performance standards can minimize waste, especially because of their long development time and changes that may now be occurring, although it is apparent that, in certain cases, performance standards can be effective in volume and toxicity reduction. Achievable reductions would also vary depending on the specific industry or process involved.

While EPA has not utilized performance standards for the reduction of hazardous wastes, it obviously has considerable experience with their application to reduce air and water pollution. Under the Clean Air Act, performance standards have been established for emissions of "criteria" pollutants from new stationary sources (New Source Performance Standards) for each major category of pollution source for criteria pollutants. Existing facilities are similarly regulated through Reasonably Available Control Technology (RACT) performance standards, which are applied to facilities through State regulations. These air pollution standards apply only to criteria pollutants and are not for specific toxic pollutants. The only air standards intended specifically for highly toxic pollutants are the National Emissions Standards for Hazardous Air Pollutants (NESHAPs).

Under the Clean Water Act, effluent limitations are established for both "conventional" and toxic pollutants. These effluent standards are discussed in more detail later in this section. Under both statutes, periodic review of the performance standards is required to take into account new technological developments that could permit more effective control.

Limitations on the volume and toxicity of hazardous wastes could be similarly established for specific industrial categories. The major difference would be that performance standards for hazardous waste minimization would usually be based on the potential for reduction resulting from process changes rather than on end-of-pipe controls, which is generally how performance standards are developed under the air and water programs. (Exceptions would be requirements based on good operating practices, such as segregation of different waste streams to facilitate recovery or treatment, requirements based on raw material substitution, or requirements based on recycling of specific wastes after their generation.) Because hazardous waste minimization standards would frequently be based on process modifications, their design would require substantially more process-specific information than the Agency currently has available, as well as the development of substantial new expertise on industrial processes within EPA.

Performance standards can be structured many different ways. They can be developed for all sources in an industrial category, or they can be limited to only the larger sources or to only new sources. The approach can be targeted for certain high volume or high toxicity waste streams. Performance standards can focus only on source reduction or they can be based on recycling.

The type and scale of the program selected will have a significant bearing on both the costs and time required to implement the program. It is not feasible at present to make accurate estimates of the costs of implementation of developing a full scale performance standard. However, it is believed that the program would be similar to the costs of implementing the Clean Air Act and Clean Water Act. It is likely that because of the complexity of performance standards that it will take a number of years to develop the program. Since it would require the imposition of standards and limits directly impinging on the processes of production and not simply end-of-pipe controls, it seems likely that the time required for development would be as long or longer than for the air and water standards.

One major modification to performance standards, the development of a credit system, would substantially increase the flexibility of the approach. Credit could be given to a plant for recycling, incineration, or waste reduction beyond the limits of the standards; such credits might be banked against loadings from other regulated streams, based on volume or toxicity. Credits could be used by a single plant or could be made available by a plant that created them to a plant unable to meet one of the performance standard requirements reasonably. This could significantly alleviate the economic dislocation which might otherwise be caused by standards directly affecting the production processes. A credit system of this kind stands part way between a traditional performance standard system and the phasedown permits system described in the next section.[2]

The traditional approach to standards of performance has the advantage of mandating specific quantities of minimization that can be enforced. Consequently, such performance standards are popular with the general public. On the other hand, the development and enforcement of these standards would be extremely resource intensive, requiring considerable investment of time and money over a decade or more. Detailed intermedia risk evaluations would have to be done in setting up such standards.

Prohibit or restrict generation of specific wastes: Under this third option, EPA would ban or otherwise restrict the manufacture, processing, or distribution of a chemical substance. The restriction or prohibition could focus on feedstocks that are responsible for particular waste streams, and could be aimed at the waste streams themselves. The option would be mostly implemented on a waste stream specific basis, although there would be occasions to prohibit or restrict wastes on an industry specific basis.[3] It would presumably be enacted through the authority already existing under TSCA, Section 6.

This option could be an extremely powerful tool in controlling hazardous waste generation. It is probably the most direct application of a source reduction regulatory program and should be explored further. The effectiveness of this option in reducing volume and toxicity is completely dependent on which waste streams are regulated, however, and cannot be estimated at this time.

Waste generation phasedown permit program: A waste generation phasedown permit program differs significantly from the other approaches to performance standards in that it is a system of rights designed to limit the volume of hazardous wastes that generators can produce. Like other standards of performance, however, a phasedown permit program does mandate waste reduction in a direct and enforceable manner.

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[2] For a more complete description of a possible credit system, see Appendix A.

[3] For example, methylene chloride use could be prohibited as a paint stripper in certain operations where bead blasting would be appropriate.

Under this option, permits would be issued to generators (or waste treatment, storage, and disposal facilities) to allow them to produce certain quantities of wastes. Unlike the other performance standards approaches, however, these permits could be bought or sold in a market system.

Permits could be initially assigned in one of three ways: through an auction, through a lottery, or by "grandfathering." In an auction, EPA would sell the permits at a market clearing price; if EPA did not want to keep the proceeds, they could return the revenue to current generators to compensate them for their loss of generator rights. In a lottery, the initial allocation of rights would be random; there would then be a second round of transactions with lottery winners selling rights to generators with the greatest need, i.e., generators with the highest source reduction or recycling costs. Finally, in a grandfathering allocation, all current generators would receive permits for a certain percentage of their current waste generation; in the second round of transactions, generators with high waste reduction costs could buy extra permits from generators with low reduction costs.

The degree of EPA's involvement in a phasedown permit system could vary. The Agency could act as an information broker, by identifying sellers and buyers, and explaining the nature of the market and permit price. Alternatively, it could act as a certifier and enforcer of market transactions. Since a phasedown permit system would not self-enforce, the Agency might want to serve as a gatekeeper and be directly involved in approving market transactions.

Waste generation phasedown permits appear most effective for industries that are not dominated by a few major generators and would be most effective in industries that are composed of a limited number of homogeneous operations. If ownership is concentrated in the hands of a few generators, they could effectively dictate prices, defeating the purpose of the system. At the other extreme, industries with too many generators would be difficult to monitor.

Phasedown permits can also be effective in reducing the hazardous waste volume, at lower cost. Since generators who utilize low cost methods for waste minimization will find the permits most attractive, phasedown permits will have the added benefit of stimulating the development of low cost source reduction technologies. The effectiveness of this option can be limited if permits are monopolized by a few owners, a problem that could be overcome by establishing a "maximum" market share, by using an auction scheme, or by stratifying the generators by volume into separate markets. Market "thinness," the hoarding of permits in anticipation of decreases in the number and size of future permits or because of general market uncertainty, can cause this option to be ineffective.

Phasedown permits would be generally effective in toxicity reduction only as a by–product of volume reduction. EPA can specifically reduce the overall level of waste toxicity by allocating permits for different waste streams according to their toxicity. Thus, the permit for a highly toxic waste would not be used with a low toxic waste, and vice versa. This would probably be extremely difficult to design and implement, as all such constraints on the system reduce the size of the market and increase its transaction costs, thereby reducing the efficiency of the overall system.

To develop this option, EPA would first have to decide what form that the system would take. It would have to decide whether to issue permits to TSDFs or to generators.[4] It would also have to establish a waste limit, project how the amounts will change over time, and decide which allocation scheme would be most effective — auction, lottery, or grandfathering. The Agency would also have to determine an adequate term for the permits, sufficient to recoup costs of any waste reduction technology; it might also have to determine appropriate geographic restrictions for trading. Finally, EPA would have to identify a method for managing and enforcing the permits, keeping in mind that the more involved the Agency becomes, the higher its administrative costs will be.

Implementation costs would vary depending on the extent of EPA involvement, the complexity of the permit system, the method of permit allocation, and other variables.

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[4] It would be easier and less expensive to permit the TSDFs, since they are fewer in number and already require permits, thus minimizing overall administrative burden; however, the generators are the source of the hazardous waste, and permitting TSDFs would add an additional layer of uncertainty and transaction costs to the system.

Enforcement costs would be most affected by permitting TSDFs and generators. Of the two, the more ubiquitous generators would have the highest enforcement cost.

EPA might need additional legislative authority to implement such a program depending upon the format to be used to allocate permits. When the Agency attempted to use this type of approach for chlorofluorocarbons under TSCA, it felt that it did not have the legal authority to auction permits, but that it could distribute them with a lottery or by a grandfathering scheme.

Recommendations on standards of performance: The most important drawback to the use of any form of standards of performance for waste minimization is that they would mark a major departure from the traditional methods authorized by Congress for the control of pollution. Although certain statutes, most notably the Toxic Substances Control Act, give EPA the power to control production processes and production decisions directly, this authority is rarely used. The vast majority of controls enacted under RCRA, the Clean Water Act, and the Clean Air Act are end-of-pipe measures; although examples exist where processes have been directly affected by regulations, these are the exception rather than the rule.

The implementation of any of these options would require (1) data collection to identify target industries, processes, and substances and the (2) drafting of the necessary regulations. Because of the information needs, the Agency estimates that the total time to implement any of these options would be at least five years after authorization, and more probably seven or more. Therefore, there could be significant delay before the effects of performance standards would be felt. In the meantime, changes due to the land disposal restrictions program may make standards inappropriate, unnecessary, or ineffective.

All standards of performance would require intensive government involvement in development and enforcement. The burden on States may be inordinate without technical assistance from the Federal government. In addition, while it is true that many of the costs of waste minimization through standards of performance will eventually be passed on to the consumer, it is not at all clear whether the reductions in damage to the environment and human health are commensurate with increased costs. Additional study is needed to resolve this issue.

Because insufficient data are available to establish an accurate waste generation baseline, or to compare costs and benefits, the Agency suggests that several steps be taken before any final judgment on the desirability and feasibility of standards of performance is made:

- Before the land disposal restrictions are fully implemented by 1990, a data base should be compiled to establish:
  - — A baseline with regard to toxicity and volume of waste streams by industrial category, geographic area and size, and unit product output;
  - — A baseline with regard to recycling, treatment, and disposal practices for those waste streams;
  - — Short-term trends in these figures;
  - — Changes in manufacturing processes that result in reduced generation of waste; and
  - — Changes in recycling, treatment, and disposal practices.
- EPA should then evaluate the impact that standards of performance might have on waste minimization. It may be apparent at that time that certain industrial sectors have not minimized wastes to the extent technically and economically feasible and desirable, or that particular waste streams still pose significant environmental or human health hazards.
- Where, as a result of these analyses, it is determined that performance standards are the most appropriate means to ensure further necessary reductions in hazardous waste, EPA would then undertake the development of such standards. To the extent feasible, generators should be provided maximum flexibility in meeting these reduction requirements, possibly including some form of the credit system.
- Where specific hazardous waste streams are identified as causing potentially critical environmental problems or human health risks between now and 1990, specific interim performance standards for these waste streams could be developed under Section 6(a) of the Toxic Substance Control Act (TSCA).

Legislative Changes to Certification Requirements on Generators' Manifests and TSD Permits

Among the options that Congress has instructed EPA to consider are a number of actions that, along with performance standards, would require statutory amendments. These involve changes to the certification requirements for generators established by HSWA. They include two general areas:

1. Possible changes to the requirements established by HSWA in Section 3002 (Generator Standards); and
2. Possible changes to the requirements established by HSWA in Section 3005 (Permits Standards).

Requirements for Certification of Waste Minimization: Based on the legislative history of HSWA, EPA interprets the certification requirement for generators as prohibiting the development of any formal guidance to generators concerning what would constitute appropriate waste reduction or recycling for minimizing the volume or quantity and toxicity of waste, or concerning what is economically practicable. In addition, only the generator may determine what constitutes the available practicable method of treatment, storage, or disposal that will minimize the future threat to human health and the environment .

The Senate report on the certification stresses at several points that the requirement is strictly one of self-certification.

> "While these provisions encourage the reduction of hazardous waste generated, they are directed at the generators of such waste and do not authorize the Environmental Protection Agency or any other person or organization to interfere with or intrude into the production process or production decision of individual generators... The nature of the criteria for the certification and the determination of compliance with those criteria are made solely by the generator."[5]

Proposed modifications reflect an alternative method by which EPA could determine more specifically the range of generally acceptable practices. EPA would need to acquire express legislative authority to undertake any of several initiatives in this area.

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[5] *Report of the Committee on Environment and Public Works to Accompany S. 757* , U.S. Senate, October 28, 1983, p. 66.

Current statutory requirements for certification were clearly directed at generators and do not authorize EPA to intrude into the production process via the certification. If these restrictions were relaxed, EPA could be given the discretionary authority to characterize certain process modifications as waste minimization, or to evaluate economic practicability, or both. If EPA were permitted such increased authority, the Agency might also quickly specify general practices that could not be certified as acceptable waste minimization (e.g., merely listing a waste in a waste exchange catalogue and not taking part in a waste transaction).

EPA could use such increased discretionary authority in industrial sectors where data or trends indicate residual risks to human health or the environment. The Agency could determine more precisely what practices are and are not acceptable as waste minimization for certain environmentally critical targeted industries, once the impact of the land bans upon specific industries becomes clear. These restrictions would constrain or direct industry with respect to meeting the certification requirements. But if generators were still permitted to determine the economic practicability of alternatives to their present practices, they would still retain considerable freedom of action in determining both the timing and extent of changes to their manufacturing processes. Where a generator certified that there was no economically practicable alternative to present practices, however, EPA might be provided with the discretionary authority to require that the generator submit a written justification for such a certification.

The effect of the use of such discretionary authority would be to force industry to think more carefully about the opportunities for minimizing waste. If, after these steps, the Agency still found a remaining unreasonable risk to human health or the environment, it could use authority under TSCA Section 6(a) or Section 6(b) to impose additional requirements, either generally on the handling of particular waste streams by an industrial sector, or specifically on activities of a particular generator. Examples of general categories of possible waste minimization activities might include process changes, substitution of less toxic materials, good housekeeping practices, and alternative treatment techniques.

EPA could develop such new guidance relatively quickly, i.e., within one year of authorization. (If the Agency decided to develop such guidance through rulemaking, an additional six months to a year.) The initial phases for development might be very fast, since the guidance would focus on widely known or readily available opportunities to reduce, reuse, or recycle waste. Identification of preferred management priorities for certain major waste streams could also probably be developed and coordinated with the States' technical assistance programs.

For generators required to meet the stricter certification requirements, additional costs would only occur when the generators choose to certify and describe an alternative waste minimization activity, or when they would be required to justify that there were no economically practicable alternatives to their present practices.

In order to carry out the modified certification program that has been described, EPA would require specific new discretionary authority to:

- Specify practices not certifiable as waste minimization;
- Specify practices that may be considered to be waste minimization for a specific industrial sector; and
- Require generators to submit justifications for certifications that no waste minimization alternatives to present practices are economically practicable.

Recommendations on legislative changes to certification requirements: Giving EPA the discretionary authority to specify what does and does not constitute acceptable waste minimization actions would carry with it some indirect authority to influence production processes and production decisions. The Agency believes that such discretionary authority merits further study. If EPA finds a need for longer term activities, this option could be used to prevent the implementation of ill-advised practices that could harm human health or the environment and increase the potential for constructive waste minimization. It appears feasible because its use would be discretionary (used only selectively) and because it would not entail major new programs or expenditures or interfere to any significant degree with private production decisions.

Management Practices

Management practices as defined in this report are procedures or institutional policies within a service or manufacturing operation that result in a reduction in hazardous waste generation. These measures are considered to be a step beyond the prohibitions on land disposal of specified hazardous wastes and include requirements restricting particular disposal practices, requirements relating to the handling of wastes as they are generated, and requirements related to management control of the waste generation system, such as through the use of waste audits.

Three of the waste minimization options are classified as management practices. These include: (1) banning the landfilling, treatment, or incineration of potentially recyclable wastes; (2) segregation of wastes; and (3) use of mandatory waste audits.

Banning the landfilling, treatment, or incineration of potentially–recyclable wastes: By prohibiting the landfilling, treatment, or incineration of wastes that could otherwise be recycled, EPA could indirectly promote waste minimization by forcing generators to recycle these waste streams, find source reduction methods, or stop producing the products that generate potentially recyclable wastes. Development of this option requires that target industries and waste streams be identified; alternatively, a ban might be applied "across the board" to all generators, regardless of size.

To be cost effective, the ban should be limited only to streams in excess of a specified volume or possibly a specified level of toxicity. Once the categories of regulated industries and streams are identified, EPA would have to develop a list of recyclable wastes using standard notice-and-comment rulemaking.

Banning land disposal, treatment, or incineration of potentially–recyclable waste streams would probably be controversial and possibly inefficient. Costs of recycling can be great, and the appropriateness of labeling certain wastes as "recyclable" is certain to be debated. It may, in fact, be premature to consider this option prior to determining the effect that land disposal restrictions will have on the quantities of wastes generated.

At least one State, California, has a limited ban that prohibits land disposal of recyclable wastes, but allows generators to treat or incinerate the waste. The California ban is a two-stage process;

1. A limited group of liquid wastes is banned from land disposal. The list includes concentrated cyanides and halogenated organics, strong acids, and metals exceeding specified concentrations.

2. There is a second, longer list of wastes that are part of the California waste exchange system. These wastes can be recycled regardless of concentration. Periodically, the State checks manifests from generators and notifies any facilities that have a recyclable waste that is being land disposed; approximately 60 percent of the contacted facilities were unaware that the waste could be recycled. Wastes from the remaining 40 percent are either generated in small volumes or mixed with other contaminants. California has no enforcement authority for wastes on this second list.

There are several drawbacks to this option. First, a ban is difficult to enforce. It would be most difficult to ensure that all recyclable wastes are managed in a prescribed manner, and, because a ban is expensive, noncompliance would presumably be substantial. Second, demand for many recycled wastes is currently insufficient to sustain a recycling market. EPA can help strengthen demand (and market price) by adopting other measures such as an expanded use of waste exchanges. Third, requests for variances and appeals may become burdensome. In California, for example, to obtain a variance, a generator must prove that recycling is technically or economically not feasible.

Generally, a ban is most appropriate for large generators of highly toxic wastes that can be recycled or reduced using existing technologies. A ban can be effective in reducing the volume of waste generated, but it is difficult to assess its effectiveness in reducing the toxicity of waste that is generated, since any measurement is dependent on the volume of wastes that are classified as recyclable and the degree of industry compliance.

Bans would be an expensive approach to waste minimization. Costs to industry can be minimized by properly targeting appropriate waste streams, based on the volume of wastes, toxicity, and technical and economic feasibility of recycling. Government costs for both development and enforcement of a ban would also be high. EPA would first have to define "recyclable" and formally identify recyclable streams. Since at a high enough cost almost any stream can be recycled, costs will have to be considered in defining "potentially recyclable." If costs were too great, a firm would simply stop producing the waste–generating product. The major drawback of this option is its lack of enforceability. To enforce a ban, EPA would have to discover violations before the wastes have been managed. It may be difficult to identify whether a waste was defined as recyclable after it has been treated or disposed of. The Agency must determine whether a two-stage ban framework like that used in California is preferred. Such a determination should also address the magnitude of expected reductions in toxicity or risk which might result from EPA adoption of this approach to a ban.

The regulated community is likely to consider this option inequitable because its costs are high and its perceived benefits low. Generators and managers are likely to argue that (1) the option is inequitable, since all waste streams and all generators are not equally regulated, and (2) they already comply with Subtitle C regulations for managing waste, which were established to protect human health and the environment.

Segregation of wastes: This option would ban the mixing of waste streams that are determined to be potentially recyclable. EPA would decide when waste stream segregation would be required based on the same types of technology evaluations and economic analyses that are currently used to make the technology based performance standard determinations under the Clean Air and Clean Water Acts. This type of management practice could include the isolation of hazardous materials from nonhazardous materials, the isolation of hazardous waste by contaminant, or the isolation of liquid from solid waste.

To encourage segregation, EPA would have to develop an industry or process–specific "best management practices" approach, similar to the technology-driven standards currently used in Effluent Guidelines (under the Clean Water Act) and New Source Performance Standards (under the Clean Air Act). This process specific approach is not applicable to all waste streams and, in fact, would be limited only to situations where multiple waste streams have historically been combined prior to disposal. While it would indirectly encourage recycling, it would not specifically require that wastes be reclaimed and reused.

The potential for segregation of waste streams is industry specific and would vary depending on the process being used, as well as the age of the plant, its physical layout, economics, and other factors. Standards could be established for new sources only, or for both new sources and existing sources. In order to identify target industries, a survey would have to be undertaken to identify industries where segregation of wastes could actually achieve significant reductions in wastes. The survey and the subsequent industry specific analyses would be both resource and time consuming; such studies would be similar in scale to those described in relation to standards of performance. (If standards of performance were integrated into the comprehensive waste minimization strategy, then an assessment of the potential for, and the implementation of, waste stream segregation could be incorporated at minimal additional effort and cost.)

Onsite recycling potential would have to be determined through industry analyses. Information on what materials could be recycled offsite could be developed through industry analyses and data obtained through waste exchanges.

Some preliminary studies have been performed to evaluate the potential impact that waste segregation could have on minimization. There are many instances where the potential for recycling would be substantial if appropriate wastes were segregated. For example, pesticide formulaters could reduce waste volumes by using air pollution controls (baghouses) dedicated to collecting a single type of dust, e.g., pesticides. This would eliminate the contamination of one waste stream with a second waste, thus expediting recycling or reuse of the recovered materials. Other cases where segregation appears to be attractive include segregating aqueous and oily wastes in petroleum refineries, wood preserving where "good operating practices" could be used to separate hazardous from nonhazardous contaminants, and segregating rinses at electroplaters.

It is impossible at this time to estimate quantitatively how effective waste segregation would be in minimizing the quantities or toxicities of wastes generated nationally. It is clear, however, based on information already available, that certain streams that are indeed quite toxic. Notable among these streams are solvent-laden wastes generated during the cleaning of equipment and metal surfaces, pesticide dusts collected in baghouses at formulators, and an assortment of wastes containing levels of highly toxic organic compounds and metals.

The segregation of wastes does have the potential in selected instances to be economically attractive. It could, in fact, save some firms significant sums of money by reducing treatment and disposal costs, lowering expenses for the purchase of raw materials, and/or generating a reclaimed product that can be marketed or sent to a waste exchange. Waste stream segregation might therefore become economically attractive without additional regulation. It is conceivable that new prohibitions on land disposal and dramatically increased costs for all forms of disposal, coupled with substantial efforts to increase industry awareness of recycling possibilities, could provide adequate information and incentive for segregation without requiring any action though regulation.

It is impossible to estimate the cost to develop and implement technology based standards for segregating wastes. Information will be needed concerning which industries and processes can segregate their waste, monitoring data will be needed to characterize the streams, and data will be needed on the costs of process and treatment modifications and the economics of the affected industries. In addition, a survey would have to be undertaken to ascertain whether markets exist for recycling the segregated wastes. If performance standards were required for specific industries, best management practices such as segregation would most likely be considered in the development of those standards. The costs of segregation would also be considered an integral part of the implementation of those regulations. These costs could be high if other performance standards are not considered. In the absence of other performance standards, these costs will likely be comparable to the cost of developing the performance standard programs dictated by the Clean Air and Clean Water Acts.

While TSCA Section 6(a) authority might be used to require waste segregation in some circumstances, additional legislative authority would be needed if waste segregation were to be mandated on a more comprehensive basis.

Mandatory waste audits: As an additional management practice, firms could be required to carry out waste audits to identify possibilities for reduction and/or recycling of wastes. This requirement could be made generally for all generators (with a possible exclusion for small quantity generators) or limited to specific industries of special concern. As discussed here, firms would simply have to meet the auditing requirement, with the information retained for their own use. The assumption behind such a requirement would be that identification of opportunities for waste reduction (and elimination of products and/or raw materials) would provide sufficient incentive for the firms to take action.

An alternative approach to a waste audit requirement would be that information from such audits would have to be made available to EPA. The Agency would then determine whether a generator was doing all that was possible to minimize wastes. But such a use of audit information would raise considerably greater problems and objections, to say nothing of enormously higher Agency management costs, than would carrying out the audit for internal use.

There are several elements to a waste audit:

- Identification of waste streams and flow rates in the facility being audited;
- Delineation of waste generation problems;
- Suggestion of a range of solutions for each of these problems;
- Screening to determine which of these potential solutions should be studied more thoroughly (using criteria based on feasibility, effectiveness, cost, and current application experience within industry);
- Documentation of these options and presentation to, and discussion with, plant personnel;
- Final rankings of most reasonable options in light of evaluation and discussions.

The next steps—the actual selection and detailed analysis of one of these solutions to determine whether it is actually the option of choice—would go beyond what is generally considered to be part of the scope of the waste audit.

Were waste audits to be required, there would be two primary types of industries to which the requirement could most readily be applied. First, the requirement could be imposed on all industries that produce large volumes of hazardous wastes or highly toxic hazardous wastes (e.g., within the organic chemical manufacturing industry, epichlorohydrin manufacture, 1,1,1-trichloroethane, or vinyl chloride manufacture). This would include some of the largest facilities, many of which may be well controlled now, on the basis that a small percentage reduction could still make a significant difference in the total volumes of waste generated. It is likely that many or most of these facilities already have a comprehensive auditing program.

Another type of industry group to which such a requirement might be applied would be an industry characterized by large numbers of smaller facilities, significant resemblance in operations, and the generation of large volumes of highly toxic wastes. A principal example would be the electroplating industry (SIC code 3471).

Since it is not possible to determine ahead of time what actions companies would take on the basis of mandatory waste audits, it is not possible to anticipate what reductions in the volume or toxicity of wastes would be achieved as a result. Certainly some reductions would be achieved—most particularly in those plants that would have chosen to undertake such audits on a voluntary basis. Further, the kinds of changes which would result from carrying out the recommendations of such audits would be unlikely to have perverse side effects, such as intermedia pollution transfers.

So long as there is no specific requirement to achieve reduction or recycling levels found possible on the basis of the audit, companies would only act in circumstances where they saw benefits in terms of reduced liability, reduced disposal or compliance costs, or reduced raw material requirements. These conditions are analogous to those that would lead to action by generators under the technical assistance programs (see below).

While the direct costs of waste audits for industry are not extremely high (on average $10,000 to $20,000 for an uncomplicated facility), requiring industry to carry out waste audits could have some other detrimental effects. A crucial element in the success and usefulness of such audits is the commitment of management to their value. Where management has committed to carrying out a waste audit in order to identify waste minimization opportunities, the probability of effective use of the results in redesigning plant operations or waste management is increased. If waste audits were imposed as an external regulatory requirement, this commitment would often be lacking.

While waste audits are less comprehensive in scope and objective than a complete environmental auditing program, EPA believes that the final guidance adopted by the Agency for environmental auditing (51 FR 25004, July 9, 1986) is appropriate for waste audits as well: "Because environmental auditing systems have been widely adopted on a voluntary basis in the past, and because audit quality depends to a large degree upon genuine management commitment to the program and its objectives, auditing should remain a voluntary activity."

Primary equity considerations for industry would argue that audit efforts carried out before the institution of such a requirement could be credited. Otherwise, States would have a greater concern that existing voluntary programs would be undercut, and that industry might be less interested in cooperating with the States to reduce pollution as a result.

Implementation costs for the Federal government would be limited if the only requirement were that all facilities undertake an environmental audit. The only development, implementation, or enforcement costs for government would be the cost of notifying all generators of the requirement and ensuring that audits are completed. Substantial additional costs would be incurred if a decision were made to subsidize waste audits for small quantity generators, or if EPA were to decide to analyze audit results in any way.

Requiring a waste audit of all generators would probably require additional legislative authority, although it might be argued that authority already exists under Section 8 of TSCA.

Recommendations on the use of required management practices: While all of the options discussed under this section would have positive effects on waste minimization and are therefore desirable as part of a waste minimization strategy, the Agency believes that many of their goals can be reached through voluntary adoption of the measures, that mandatory requirements would add little to the effectiveness of each measure, and that such requirements would entail significant enforcement costs. Where voluntary compliance with this type of action is not likely (such as in voluntary segregation of wastes for recycling), it would be most feasible to couple adoption of the option with the adoption of a broader performance standard program.

Other Options Identified by EPA

Other options for waste minimization identified by the Agency include activities that may already exist in some form within Agency programs. Although existing Agency authority may be adequate, development of any of these activities as part of a new waste minimization program would often require significant increases in program resources and deliberate redirection of activities toward specific objectives of waste minimization. Among the additional options identified by EPA are (1) development of a significant technical assistance effort to promote and explain waste minimization and (2) revision of government procurement practices to avoid unnecessary discrimination against recycled products and to support actively the development of markets in recycled commodities.

Technical assistance programs: EPA's current role in developing technical assistance programs to promote waste minimization is one of facilitating and coordinating with the States to make State efforts more productive. State programs attempt to accelerate the dissemination of information on waste minimizing technologies and practices to waste generators and TSD facilities. Other State activities offer financial assistance to generators to support investment in waste reduction or recycling technology which the generators might not otherwise undertake. Despite the strong existing incentives for waste minimization discussed earlier in this report, EPA's role could be considerably expanded into an active, aggressive, and sustained program of technical information. An expanded EPA support role could accelerate development of existing State programs, encourage the initiative of new waste minimization programs in the remaining States, and improve coordination of State activities by providing those centralized services which would make efforts of many States more productive and minimize unnecessary duplication of States' efforts. An expanded technical assistance program appears to be the strongest option available to promote waste minimization, especially in the near term. The program's purpose would be to encourage firms to include affirmative waste minimization options into their hazardous waste management planning and, where necessary, to provide access to technical information and assistance, and to encourage the development of markets for recyclers and recycled materials.

To support this program, EPA could develop a computerized information system on waste minimization which would be accessible by the States. Such a data base could alleviate problems in several areas of concern to States and generators alike. Its categories of information could include:

- Current literature on waste minimization technology: Some of the periodicals of potential interest are already accessible on commercial data bases. This is one source of information on waste minimization technology, but other sources might include published and unpublished local, State, or Federal government documents. Documents could be key worded around pertinent waste minimization topics.
- Indices of current and planned research programs: It is often extremely difficult to identify useful research programs and projects. Putting State, Federal, and private research programs on one data base would greatly facilitate access to emerging information.
- Cross tabulation of State/Federal activities: This aspect of the data base could help transfer information rapidly among States, cutting down duplication of effort and expanding the awareness of the most successful waste minimization approaches.

An expanded EPA technical information program could directly increase technical resources to industries previously targeted by several State programs. Research studies on technology, technology transfer, multistate market analyses for waste recycling and treatment, and economic analysis of commonly encountered barriers to increased waste minimization could also be conducted.

Appropriate target industries would depend, to a significant extent, on the needs of the individual States. Generally, however, the focus would be on small and medium–sized facilities (though not necessarily small quantity generators). Furthermore, many States have similar industrial environmental problems. Electroplaters, paint manufacturers, printing operations, dry cleaners, and organic dye and pigment manufacturers could all benefit from a technical assistance program.

It would be difficult to determine what reductions in volumes or toxicity would result from an active technical assistance program. But some of the industries listed above (e.g., electroplaters and pesticide manufacturers) generate highly toxic waste streams, and the generators who would benefit from such a program would often be those with inadequate controls.

One critical benefit of technical assistance is that it can be started immediately and can show at least some benefits within months of enactment. This may be of critical importance in the initial stages of the land disposal restrictions, as generators begin to make long-term commitments to hazardous waste management. Many who would otherwise opt for waste minimization might instead commit to some other option, such as onsite treatment.

The principal drawback of a large scale commitment to technical assistance is that it is a departure from past EPA practice, which has been traditionally oriented around the promulgation and enforcement of regulations. While past experience with technical assistance programs and other nonregulatory approaches to pollution control have often been unsuccessful, there are several important reasons why a high-visibility technical assistance effort, if sustained over the critical next five to ten years, could produce substantial results:

- It would not be moving against industry's natural intentions: The program would be promoting and expediting a trend that already has strong economic momentum within industry.
- It would not be an independent effort: The program would directly supplement the existing regulatory programs to which Congress has already committed the Agency.
- It would work primarily through the States: EPA's role would be in coordination, and provision of resources, guidance, and computerized information. EPA would not be in a position of engaging directly in local contacts.

Procurement Practices

Government procurement programs may provide a means to create additional demand for products made with less hazardous materials. This option would involve establishing procurement regulations or guidelines to encourage the following:

- Additional recycling of waste materials in certain types of products; and
- Greater emphasis on waste minimization in the manufacture of particular products based on the existing authority of RCRA Section 6002 (Procurement) which provides authority for general procurement which is limited to Federal agencies. The object would be to avoid needless discrimination against recycled materials (such as currently exists through provisions requiring the use of virgin materials, rather than materials equivalent to virgin material specifications). It would also actively promote (though it could not require) government acquisition of recycled materials. This would have the effect of legitimizing a market for recycled materials.

In those instances where a Federal preference for a recycled product may make the product economically viable, EPA should work with agencies that are in the best position to create such markets. For example, the Department of Defense (DOD) has the largest procurement operation in the country. It might be possible in cooperation with EPA to help establish a program whereby DOD might establish a preference to procure recycled commodities.

Although DOD is currently in the process of developing a comprehensive waste minimization strategy, thereby providing an opportunity for EPA to coordinate joint development of a procurement strategy focused on Federal agencies, development of such a strategy would still be a long and complex process. Significant research and analytical efforts would be needed to determine the extent to which recycled materials could substitute for virgin materials for various government requirements. Moreover, analyses of the approximate volumes of wastes associated with the various types of products purchased and used by Federal agencies (e.g., printed circuit boards, which are purchased in large quantities by DOD) would be needed to establish a baseline against which reductions in waste could be measured.

Development of a policy that focuses on the manufacturing process rather than on the material characteristics of the product would certainly have difficulties in data collection and development of a baseline, and would be difficult to enforce. Such an effort to change the purchasing habits of the Federal government is nevertheless consistent with the national policy of minimizing wastes, and should probably be given significant priority over the long term.

Recommendations on the use of other options for waste minimization: Both options discussed in this section appear desirable and feasible. The adoption of technical assistance programs, however, seems particularly desirable in the near term. It appears to be the only approach available that can promote significant additional waste minimization action without large additional costs or years of delay. It also has the flexibility to adapt to changing hazardous waste management program and waste minimization needs.

Chapter Four

RECOMMENDATIONS

The preceding chapters have summarized EPA's current knowledge about the generation and recycling of hazardous wastes, reviewed State efforts to minimize waste, and evaluated several options for Federal waste minimization initiatives. This chapter provides an overview of a program that EPA believes will provide the most productive long-term strategy for waste minimization. Most of the discrete recommendations in this chapter have been discussed in the previous chapters. The objective of this discussion is to show how these elements, taken together, compose a program that increases the potential for waste reduction and recycling.

EPA believes that waste minimization must be implemented as a general policy throughout the hazardous waste management system and, ultimately, more broadly throughout all of EPA's pollution control programs. In the short term, efforts within the Office of Solid Waste should focus on the development of needed data on hazardous waste management trends and issues, set up lines of communication to the States and to industry, and develop needed technical assistance tools to enhance industry's natural incentives to reduce hazardous waste generation and enhance recycling. It is also necessary to begin the process of setting priorities for future waste minimization programs so as to respond most aggressively to problems that cannot be addressed adequately by the existing elements of the waste treatment program or by EPA programs with jurisdiction over the other environmental media.

In the design of a waste minimization strategy, it is particularly important to distinguish between short–term and long–term objectives. As has been stressed throughout this report, the nation's waste generation and waste treatment patterns will be in a state of flux over the next several years. During that same period, firms will make waste management commitments that may be difficult to change—if the Agency fails to act aggressively, it may miss a unique opportunity to make source reduction and recycling a more widely–adopted industrial strategy for hazardous waste management.

Over the short-term, waste minimization efforts must concentrate on data development, on information transfer, and on any and all methods available for increasing industry's awareness of waste minimization as a constructive and economically–efficient approach to hazardous waste management. The Agency must also lay the analytical ground work for deciding how and where it can focus source reduction and recycling to ease treatment and disposal capacity shortages. Over the longer term, waste minimization priorities can turn increased attention to ways of reducing or recycling wastes that cause the greatest environmental risk. If long-term controls targeted at particular environmental problems are found necessary to protect human health and the environment, these programs will demand considerable technical insight into waste generation processes, disposal options, and health and environmental damage as analyzed from a multimedia perspective. One mechanism to address problems at this level could indeed include performance standards similar to the engineering controls already in place in the air and water programs (Air Emissions, New Source Performance Standards, Effluent Guidelines), but, as has been emphasized in Chapter Three, performance standards for waste minimization raise a number of troublesome issues and may not be warranted.

Writing waste minimization performance standards would involve the Agency in the internal operation of industrial processes to a far greater extent than has been true in other environmental programs. Difficulties would include (1) protecting the confidentiality of proprietary processes and production specifications, (2) ensuring adequate flexibility in standards to meet variations in plant capacity, age, design, and production goals from firm to firm, and (3) maintaining reasonable process efficiency and profitability, consistent with waste minimization objectives. In all these areas, it can be argued that market forces are more efficient than prescriptive regulations.

As has been emphasized in Chapter Three, writing efficient process standards for a broad range of industries would also be at least as difficult an undertaking as developing New Source Performance Standards or Effluent Guidelines. Like the other regulatory programs, the cycle of writing and implementing the initial round of regulations would most likely require seven to ten years to complete. Such a major commitment would be expensive and would have to produce environmental results commensurate with its investment. The data are not yet available to determine whether or not this is possible.

Equally important is the issue of timing. Assuming that Congress were to mandate a command-and-control approach to waste minimization in the near future, it would then take several years to write and issue standards. Judging by the schedule of the effluent guidelines program, or even the more rapid HSWA land disposal restriction program, large-scale implementation of such a program would probably not yield observable reductions in waste generation until after the year 2000. As noted already, they would have no value in alleviating short-term capacity constraints.

Finally, there is the issue of equity. Economic incentives for minimizing wastes have been particularly strong over the last five years, and many firms have already implemented process modifications or taken other measures to reduce or recycle the amount of waste they generate. Some plants are approaching practical limits for reducing or recycling the wastes created by their production, but existing information suggests that progress in this direction is uneven across industries and firms. Stringent requirements to minimize wastes across the board, such as by a fixed percentage across multiple industrial sectors, might therefore be grossly inequitable, penalizing firms that have already minimized their wastes, rewarding those that have not. It is therefore important to define correctly the starting point from which waste minimization programs should begin. The Agency must develop a general consensus about how to define an equitable baseline from which waste minimization progress can be measured.

Given the legal, technical, and scheduling problems inherent in performance standards and the need to act quickly to establish stronger waste minimization policies, it is clear that additional types of waste minimization options must be considered, especially in the short term. This report has therefore described a range of nonregulatory controls, including various positive incentive programs, such as information clearinghouses, technology transfer programs, waste audits, and various other types of technical support.

Many of these appear promising, but they too have their drawbacks. To make a significant impact on waste generation, such programs would have to be intensive and well directed. As a regulatory Agency, EPA has never attempted to mount a significant technical assistance effort within any major environmental program. Although the Agency has had experience with nonregulatory programs in the past (such as the transportation planning requirements in the air program, wetlands protection efforts, the Buy Quiet Program, the Chesapeake Bay and Great Lakes Programs, the agricultural lands program, and areawide wastewater treatment planning), these have tended to be peripheral to the major regulatory programs and have often met with mixed success due to lack of sustained commitment, or because their environmental goals were ambiguous.

The Agency believes that nonregulatory options will be among the most efficient ways to reach waste minimization goals, but intensive implementation of a strategy relying on nonregulatory approaches will demand strong support and direction from Congress. It will also demand close cooperation with the States. Waste minimization is largely industry-specific, and only the States have the close knowledge of local industry that would be necessary to ensure successful implementation of nonregulatory programs. If adopted as priorities by EPA, these programs would best be implemented through the States, with EPA providing resources and technical capabilities.

EPA's Recommended Waste Minimization Strategy

EPA's most pressing initial needs are to obtain more accurate information on the current status and trends of hazardous waste generation and management in the United States and to initiate activities that will encourage immediate efforts by generators to minimize wastes. Over the longer term, as the information on trends in waste generation provides more insight into residual risks to human health and the environment, the Agency can institute additional measures to minimize those wastes that still create a human health or environmental hazard.

The Agency has concluded that mandatory standards of performance and required management practices are not feasible or desirable in the near term. If, after implementation of other pertinent provisions of HSWA, the Agency determines that additional regulations or other requirements are needed in order to protect human health and the environment, it will then request additional authority from Congress. As noted below, EPA will report back to Congress on this issue in December 1990, the earliest date at which it believes a recommendation on the need for a mandatory waste minimization program could be made.

EPA does, however, plan to enhance its current waste minimization efforts as discussed below in the context of a three point waste minimization strategy to which EPA hereafter is committed.

The elements of this strategy are:

1. **Information Gathering:** Detailed data on industry's response to the land disposal restrictions program and other existing waste minimization incentives must be gathered in order to make a final determination on the desirability and feasibility of performance standards and required management practices.
2. **A Core Waste Minimization Program:** During the interval when the new provisions of HSWA are taking effect, EPA will launch a strong technical assistance and information transfer program through the States to promote voluntary waste minimization in industry, government, and the non-profit sectors of the economy. It will also work with Federal agencies to encourage procurement practices that promote the use of recycled and reclaimed materials.
3. **Longer Term Options:** Based on an analysis of the new data gathered under (1) above, performance standards and other mandatory requirements can be imposed, if necessary, once the HSWA amendments have taken full effect and their impacts on waste generation have been assessed.

Information Gathering

Agency actions to encourage waste minimization, whether through voluntary means or through future regulatory action, must be based on a full understanding of the present state of hazardous waste generation and management and of how that system is evolving under the many pressures to which it is now being subjected. The general patterns and trends of hazardous waste management systems are becoming clearer, but past trends may not persist through the next four to six years as HSWA's new provisions take effect, and as industry seeks to control the potential financial liabilities associated with hazardous waste management.

Baseline and trends data: The best data available to the Agency on the amount and content of hazardous wastes were developed by surveys conducted in 1981 and 1983. These data are rapidly becoming out of date and are known to be of uneven quality because of reporting errors and the small and variable sample sizes from which information was extrapolated. They must be supplemented with new data documenting the changes that have already begun and will continue to progress over the next few years.

In order to make a final determination on the desirability and feasibility of mandatory waste minimization actions, the Agency must be able to document unresolved environmental problems for which such a new regulatory programs would be the appropriate response. One example of an unresolved problem would be the continued generation of waste streams for which treatment and disposal capacity remain inadequate even after land disposal restrictions have been in place for a year or more. Another might be a determination that certain types of hazardous waste treatment do not, in practice, adequately protect human health and the environment.

The types of data needed include detailed baseline information on the volumes and toxicity of wastes generated, trends data on source reduction and recycling, trends data on treatment and disposal capacity, and analyses of the health and environmental impacts of treatment and disposal practices. No new statutory authority is needed to gather this additional data. One potential source will be the biennial reports, which will be upgraded to improve the consistency and coverage of the information submitted. Other sources include a possible new generator and the 1986 TSD survey, information developed by EPA programs outside of the Office of Solid Waste (such as under TSCA), and the reporting requirements that may be enacted under amendments to CERCLA.

Data to support technical assistance and information transfer: Much of the same data can be used to set priorities for technical assistance programs to promote source reduction and recycling programs, targeting them where they will be most successful in reducing threats to human health and the environment. However, more detailed information on the cost and effectiveness of specific waste minimization techniques will also be needed for the targeted industries. This information gathering program will enable EPA to develop an accurate profile of waste management trends and practices and to develop performance standards or other requirements selectively as needed.

Data to support possible new regulatory programs: If the trends data demonstrates the need for mandatory measures, more detailed information will be needed, as it is in any regulatory program, to support the development, implementation, and enforcement of new regulatory actions. This additional information would be developed selectively, and would build on the baseline data already established.

EPA believes that existing statutory authority is sufficient to gather the additional data on which long-term waste minimization planning will depend. Based upon the policy and objectives for RCRA established in Section 1003, the Agency recommends the immediate development of a data gathering program to undertake the following general activities:

- Develop baseline data on the volumes and detailed characteristics of wastes generated by specific sizes and categories of firms, and on the processes that generate them.
- Develop baseline data on the recycling, treatment, storage, and disposal of these wastes, including both engineering and cost elements.
- Develop trends data on the above.
- Characterize the human health and environmental risks associated with the generation and management (including disposal) of wastes that may pose significant impacts.

A more detailed listing of data needs and potential sources appears on Table 4-1. EPA is in the process of developing a detailed strategy for acquiring and interpreting this information.

Table 4-1

Data Needs and Potential Sources for Future Waste Minimization Analysis

Data Needs	Potential Sources
1. Baseline information on waste volume and mass fraction, and constituents and constituent mass fractions, of waste streams by industry category, firm size, and geographic area. Figures are needed on the basis of unit production throughput and/or input.	• New Generator Survey • Biennial Report • Section 8 of the Toxic Substances Control Act (TSCA) including information from TSCA's proposed comprehensive Assessment Information Rule (CAIR), *and/or* • The proposed Toxic Chemical Inventory in Title III of the pending Superfund Reauthorization Act.
2. Baseline information with respect to recycling, treatment, and disposal practices for the waste streams and the constituents mentioned in #1 above.	• Same sources as listed for #1. • Current Treatment, Storage and Disposal (TSD) Survey.
3. Cost figures by waste stream, volume and geographic area for alternative treatment and disposal practices. This would consist of cost information if provided by the generator or price information if treatment and disposal services were purchased commercially.	• TSD Survey. • New Generator Survey • TSCA Section 8.
4. [Recycling only] Data on market prices of the materials recycled and market prices of virgin materials for which recycled materials substitute, or, alternatively, charges paid to have the waste removed, batch tolling agreements, or direct cost of onsite reclamation and recycling.	• Surveys on commodity prices by the Dept. of Commerce. • New Generator Survey. • New Recyclers Survey.
5. Trend lines for all the above figures over a two- to four-year period.	• Use all the sources mentioned above.
6. Changes in manufacturing or waste management practices which result in any changes noted in trend lines.	• Biennial Report. • Proposed CERCLA mass balance data. • TSCA Section 8.
7. Potential exposure figures, to the extent feasible, for selected wastes as well as figures for changes in the volumes generated or in methods or levels of recycling, treatment, or disposal.	• Exposure assessements from EPA's Integrated Environmental Management Division (IEMD) Regional Hazardous Waste Pilot Project. • Resource Conservation and Recovery Act (RCRA) Risk-Cost Analysis Model.
8. Toxicity and Risk: updated and expanded hazard assessments and dose-response estimates for constituents in selected waste streams.	• Data developed by the EPA Office of Research and Development (ORD)
9. Environmental Impact Assessments for selected wastes with respect to the identification of recycling, treatment, and disposal practices.	• Case studies developed by ORD. • Modeling and analytical studies developed by ORD or OSW.
10. Consolidated human health and environmental risk assessments - comprehensive and multi media.	• Synthesis of data from all the above sources.

A Core Waste Minimization Program

Many economic incentives are already influencing industry to reduce, reuse, and recycle hazardous wastes. As noted in this report, these include current compliance requirements for environmental regulations, rising management costs, concern for future liability, and rising costs for raw materials.

As the land disposal restrictions come into force, and costs for treatment and disposal of wastes increase, these existing incentives for waste minimization will be intensified. But because of informational, technical, and economic barriers, many generators may not act on economically–beneficial opportunities to minimize wastes. As discussed in Chapter Three, EPA believes that, given the current information base, the most effective immediate action the Agency and the States can take is to help generators overcome those barriers. Several States have already devoted considerable resources to such waste minimization programs (see Chapter Two). Although EPA does currently provide some support for technical assistance to the States, funding is limited.

Recommendations: The following short-term activities should be adopted as a core waste minimization program:

- EPA should develop and publish an Agency policy statement on waste minimization including informal guidance to generators concerning what constitutes waste minimization under the reporting and certification requirements of RCRA. To the extent possible, this guidance should be specific to particular industrial sectors and processes.
- EPA should substantially expand its role in providing for technical and informational assistance to generators, including small quantity generators. Because the States have more direct contact with the generators and hence have more awareness of generators' needs and problems, EPA's primary role should be to support and encourage the States in the development of their programs.
- In the event that mandatory controls are needed in the near term to control the volume or toxicity of wastes generated by particular industries, EPA would use the authority that currently exists under Section 6 of the Toxic Substances Control Act.

- An appropriate EPA sponsored technical assistance effort could include:

  — Assistance to specific States to initiate and develop programs for providing direct assistance to generators (e.g., using waste audits, dissemination of technical information, applied research on new applications of existing technology). Special attention would be given to the unique needs of small quantity generators.

  — Highlight ongoing research and development and economic feasibility studies that might serve an entire region or have regional application (e.g., central treatment and recovery of electroplating sludges).

  — Development of an information system on waste minimization, accessible by the States, including the following types of information on waste reduction and recycling:

    (a) Technical literature and data on waste minimization organized by waste stream, industrial process, and industrial sector;

    (b) Status and interim or final results of current or planned waste minimization R&D projects carried out under State or Federal auspices;

    (c) Economic data and analyses on technology investment costs and recovery periods.

  — Reciprocally elements of an expanded EPA supported State technical assistance program are expected to include such elements as:

    (a) Technical information resource collection consisting of current literature, newsletters, directories of available recyclers and information hotlines.

    (b) Technology transfer programs that directly assist individual generators or selected industry groups with onsite waste minimization audits, onsite needs assessment, and planning and implementation of focused seminar training activities.

    (c) Information planning and development activities to fulfill generators' needs for technical analysis—prerequisite for new investments in research and development or use of alternative technologies.

(d) Administrative support and coordination of State-wide research to identify industries and waste streams creating the largest local hazardous waste problems as well as to identify and analyze economic and institutional barriers to waste minimization innovation.

(e) Administrative support and coordination of State-EPA supported waste minimization demonstration or research projects in cooperation with State universities and specific industry groups.

(f) Monitoring and coordination for planning and development of a centralized national information collection and dissemination system.

In order that the technical assistance program can remain a long-term responsive and dynamic aspect of EPA's waste minimization project, the Agency should establish a formal process of coordination with the States to ensure a continuing and responsive technical assistance and outreach effort over the long term.

In addition, EPA will continue to examine specific elements of this "core" waste minimization program, and make recommendations, if needed, for legislative changes to the existing waste minimization requirements as part of the next RCRA reauthorization. Possible options to consider would be modifications to the existing certification requirements including:

- Prohibiting, where appropriate, certification of certain types of waste management practices as waste minimization.
- Providing, where appropriate, formal guidance as to what may be certified as waste minimization. Such guidance could apply generally or to specific industrial sectors. Flexibility for appeals and exceptions must also be provided. (In any case, where a generator was not carrying out one of the waste minimization activities that had been listed as certified, the generator could specify an alternative waste minimization activity, and a rationale for certifying it as waste minimization. Unless the Agency were to place the activity on the list of proscribed practices, it would have to accept the generator's self-certification).
- Requiring generators who have not undertaken any of the approved waste minimization activities, but who certify that there is no economically practicable alternative to their present waste reduction

and management practices, to provide a written justification of such certification.

Longer Term Options

Only after the land disposal restrictions and other principal provisions of the HSWA go into effect, and after EPA has developed the needed additional data on hazardous waste generation and management, will it be possible to assess whether standards of performance (including phasedown permits) or required management practices (such as waste audits) are necessary to achieve additional reductions in the volume or toxicity of wastes. The Agency therefore recommends that consideration of new mandatory programs be deferred until after such data can be gathered and analyzed, and proposes to report back to Congress on the desirability and feasibility of prescriptive approaches two years after the first of the land disposal restrictions has been fully implemented. Excluding the possibility of a one–year case-by-case extension (renewable for one additional year), the first of the land disposal restrictions will be fully implemented in November of 1988; EPA will therefore make its next formal report on this subject in December of 1990.

Recommendations: The following longer term activities should be adopted to augment the core waste minimization program consistent with the findings of additional technical and policy analysis:

- EPA recommends that any decision on whether to require the adoption of performance standards or specific waste management practices to bring about waste minimization be deferred until there has been time to evaluate trends and residual problems evident in the data.

  EPA will report to Congress on the desirability of prescriptive approaches to waste minimization two years after the first of the land disposal restrictions have been fully implemented. Since, with possible two-year variances, the first of the land bans will be fully implemented in November of 1988, EPA will make its next formal report to Congress in December of 1990. This will provide EPA with an opportunity to review changes in waste generation and management patterns.

Conclusion

EPA still has much to learn about waste minimization and recognizes that the cooperation of private and public waste generators will be invaluable as it moves toward the development of sound long–term policy. It also believes, however, that the incentives and trends within the hazardous waste management system are unmistakable, and that the program presented here comprises the most positive and constructive steps that can be taken at this time. Aggressive action in favor of waste minimization is clearly needed, but a major regulatory program—at least for the present—does not seem desirable or feasible.

Incentives for waste minimization are already strong, so EPA must capitalize on them. Most often lacking is access to the information that will demonstrate the economic benefits of waste minimization to industry, overcome logistical problems, and help develop creative new approaches. This can be provided by a strong technical assistance and information transfer effort, which can achieve through voluntary means what would be inefficient and possibly counterproductive to attempt through regulation. Unfortunately, non-regulatory programs have often failed at EPA for lack of statutory or regulatory deadlines, and institutional advocacy. For such a program to work, it must be given strong organizational support within the Agency.

EPA is willing to make this commitment, and seeks support from Congress to ensure its success.